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CONTENTS.

	PAGE.
The Entomological Conference	317
Conference Notes	318
Agriculture in Bermuda	319
The Canary Banana	320
Coffee in French Colonies	325
Cotton Prices	326
Sugar Abstracts	331
Thrips Control	332
Nodule Organisms	334
Fibre Production	335
Tropical World Notes	336
Sugar Notes	338
Fruit Notes	339
Mycological Notes	341
Chemical Notes	342
Sisal in East Africa	342
Mr. Gaston de Verteuil	343
Sir Francis Watts	343
Agricultural Excursions	343
College News	343
Trend of the Markets	344

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THE ENTOMOLOGICAL CONFERENCE.

THE Conference[1] of Empire entomologists which was held in London this year was the third quinquennial gathering of its kind and was attended by delegates from no fewer than 23 oversea Governments, in addition to representatives of Government Departments in the United Kingdom and of other stations and institutions. The Imperial College of Tropical Agriculture was, it will be remembered, represented by Mr. F. W. Urich, Assistant Professor of Zoology and Entomology and by Dr. J. G. Myers, who on behalf of the Empire Marketing Board is investigating the problem of the biological control of insect pests in the British West Indian area.

The main objects of the Conference were to enable entomologists from all parts of the Empire to discuss together problems of common interest and pool the experience which they had gained in their different fields; and to permit of the work done by the Imperial Bureau of Entomology during the past five years being discussed, and its programme for the ensuing period being submitted for criticism and suggestions by those for whose assistance it had been created. It will be generally known that the Bureau, ever since its inception, has always been very closely associated with entomological work in the British Empire. Since the last Conference this work, however, has developed considerably and amongst the many new projects carried out, the most notable in the history of the Bureau has been the establishment of a Parasite Laboratory[2] at Farnham Royal for the breeding of beneficial parasites for export to oversea territories of the Empire. With a noticeable expansion of entomological staffs in many of our tropical possessions the Bureau has had many additional responsibilities and had in recent years obviously outgrown its original conception of an office for the collection and dissemination of technical information. This was recognised at the first meeting of the Conference when it was decided that this organisation should, in future be known as the "Imperial Institute of Entomology," a title which much more adequately represents the scope of its activities and influence. The Conference in appreciation also of the services rendered by the Imperial Institute of Entomology to scientific workers in the British Empire urged the importance of adequate support being given to enable its

essential services to be continued and, as necessary, expanded, while it emphasized the necessity for devising means to place the Institute on an assured and permanent basis.

Many subjects of scientific interest were discussed at the Conference and judging from the large attendance of visitors it is clear that public interest has awakened considerably in recent years to the importance of applied entomology in dealing with the agricultural, veterinary and public health problems of the Empire. The subjects actually dealt with included the organisation of entomological departments; entomological work among the backward races; tsetse control; the control of insects by cultural methods; locusts; the biological control of insects; the control of weeds by insects and the control of orchard pests. It will be seen that there was ample scope for discussion in the wide range of subjects chosen and those who are particularly interested will find the opinions of delegates expressed in the Appendix to the Report of the Conference.[1]

Perhaps one of the most interesting papers prepared for the Conference was a summary[3] of data relating to economic entomology in the British Empire, where an attempt was made to indicate the enormous losses caused by agricultural pests to our Empire and to summarise the expenditure incurred by its entomological service. In Canada, for instance, the losses to field and fruit crops and to forests have been estimated at £30,000,000 per annum; in Queensland they have been estimated at £2,000,000 (including those affecting the cattle industry), and for the Indian Empire at the huge figure of £136,000,000 and if to this, the losses among domestic animals and animal products are added, the total is reached of nearly £151,000,000. These figures give ample food for thought especially when they are considered in relation to the expenditure incurred by entomological departments in the British Empire. It is pointed out that the United States, with a population of some 106,000,000 spends at least £2,000,000 a year and employs not less than 500 entomologists, while the British Empire, with a population four times as numerous, spends little more than one-fourth of this and employs less than 300 entomologists. Also, if the expenditure on entomology in relation to total revenue was on the same basis as in the United States, the British Empire would be spending nearly seven times as much as it actually does. Thus it is open to question whether the Empire is bearing its share in the fight between man and insects. The contrast is greater when the dissimilarity of conditions is considered, as the problems of the United States, though on a vast scale, are limited in variety, and neglect of them would not be specially dangerous to the rest of the world, while the responsibility of our Empire scattered throughout the world and concerned with a greater range of pests and crops is a much heavier one. In the face of these data it is to be hoped that ample support will be given by those concerned to the recommendations made by the Conference and that the necessary steps will be taken to maintain the very essential services that the Imperial Institute of Entomology and other entomological institutions are rendering to the British Empire.

(1) Report of the Third Imperial Entomological Conference.

(2) A Summary of Data relating to Economic Entomology in the British Empire. S. A. Neave, M.A., D.Sc.

(3) The Biological Control of Insect and Plant Pests. —(E.M.B. 29). W. R. Thompson, Ph.D., D.S.C.

CONFERENCE NOTES.

(*a*) *Farnham House Laboratory.*

The establishment of this Laboratory was made possible by the generous support of the Empire Marketing Board, who have supplied a capital grant of £15,000 and an annual grant of £5,000 for five years, recently increased to £7,000. The Laboratory was opened in 1927 and has already, under the direction of Dr. Thompson, made several successful exports of parasites in response to demands from entomologists in various territories. It is confidently hoped that it will soon be in a position to give substantial assistance in combatting insect pests which are retarding progress in agriculture, animal husbandry, and public health throughout the Empire. Beneficial parasites have been exported to Canada, New Zealand, South Africa, New South Wales, Western Australia, India, the Falkland Islands, Barbados and Texas. Parasites exported included those of the blowfly, pine-shoot moth, wheat-stem sawfly, woodlice, Sirex, Lecanium scale, whitefly, pear slug, and the pink bollworm. Beneficial insects already exported to New Zealand for weed control include gorse weevil, blackberry borer, and ragwort moth. Dr. Myers, working in the West Indies, on behalf of the Empire Marketing Board has actually effected the introduction from Cuba into Barbados and Antigua of a Tachinid parasite (*Lixophaga diatraeae*) of the small moth borer of sugar-cane (*Diatraea saccharalis*), which gives good promise of success.

(*b*) *Control of Insect Pests by Cultural Methods.*

In this discussion Mr. Stockdale stated that he had seen a number of instances where insect pests had been satisfactorily controlled to a greater or lesser degree by cultural methods and he thought that under certain conditions, particularly in regard to permanent crops in the Tropics, this was a line to which entomologists should give their attention. He gave examples of the relation between thrips and cacao in Grenada, the relation between shade trees and outbreaks of thrips on cacao and of scale insects on tea in Ceylon. Also the shot-hole borer of tea, *Xyleborus fornicatus*, had been much reduced by attention to cultivation and by the use of nitrogenous manures. Dr. J. G. Myers thought that under West Indian conditions

many of the pests can be fairly well controlled by cultural methods. The banana weevil is almost negligible on the larger estates, but on peasant lands is likely always to be a serious pest. On the other hand, *Diatraea* is very much more abundant on sugar-cane estates than under peasant conditions. In Antigua the average stalk infestation is 80 per cent. on estates and 15 per cent. on peasant lands, and this indicates that our chief need is for a study of the biology of this moth in relation to agricultural operations. During the last seasons in the cotton-growing islands from Nevis to the Grenadines, including Barbados, the pink bollworm has decreased from 90 per cent. to almost nothing. In some islands this has been attributed to the change in planting season, but it has also occurred on other islands where no change has taken place. Dr. W. S. Martin said that in his experience with coffee in Uganda the bushes most infested with scale insects were often found to be those with twisted tap-roots or those growing on a compact subsoil that the roots could not penetrate.

(*c*) *Biological Control.*

Dr. Myers emphasized the importance of biological control work in the Tropics, where, judging from his West Indian experience, it was of greater value than in the Temperate Zones. He thought that the need for controlling insects attacking crops grown by backward races ought to be met as much as possible by methods of biological control since they are automatic. The question of biological control in continental areas was less difficult in the Tropics than in Temperate Zones, as cultivations tend to be biologically isolated and to have a considerable fauna of their own which makes them as favourably situated for biological control as geographical islands.

In the West Indies the practice of burning trash did not interfere with the balance between pests and their natural enemies, unless the percentages killed were different. With regard to the use of predators and parasites, he suggested that from a practical point of view the question was not between those with parasitic and predacious habits, but between those with more or less efficient habits (*e.g.*, specific rather than polyphagous).

(*d*) *Control of Orchard Pests.*

Dr. W. J. Hall referred to the question of unequal blossoming and the timing of spraying. In Southern Rhodesia the most serious pest is the Citrus Thrips, and the timing of spraying is of considerable importance in its control. The first application should be made at the time when the fruit is about the size of a pea, though variation in size of fruit made this difficult in practice. Blossoming can be materially affected by the organisation of irrigation, and another factor is the question of out-of-season fruit. Citrus has a certain rhythm, and if in the winter months it is carrying out-of-season fruit, the spring growth will be weak and uneven. He had found that power spraying machines require smaller gangs and fewer machines, and that it is, therefore, easier to supervise the work when using them. In his experience dusts cost more than sprays and did not give so good a kill, though it was sometimes possible to save a crop by dusting that would otherwise be lost altogether.

AGRICULTURE IN BERMUDA.

In an address delivered to the Bermuda Rotary Club, Mr. E. A. McCallan, Director of Agriculture, stated that in the years 1924-28 Bermuda had exported vegetables and lily bulbs at the rate of £142,000 a year, and had imported agricultural supplies during the same period which averaged £42,000 a year. The capital involved in Bermuda agriculture was wholly Bermudian, so that all the profits remained in the Colony. Also, most of the money made by the farmers was spent locally. New York used to be the principal market in the past but was now temporarily closed on account of high tariffs and the increased production of vegetables by American truck growers. Mr. McCallan, while discussing the potentialities of the Canadian market for Bermuda produce brought out the following points: (i) that seven-tenths of the Dominion's population was in Eastern Canada and therefore, within easy reach of Bermuda; (ii) that Canada had imported $8,000,000 worth of vegetables in 1929, of which $2,000,000 were paid for tomatoes; (iii) that the bulk of these importations were made in the winter and spring when the Colony's vegetables were exported and (iv) that Bermuda enjoyed the following advantages on the Canadian market: (*a*) no domestic competition (*b*) a tariff preference in Bermuda's favour (*c*) a friendly market anxious to buy within the Empire and particularly from the signatories to the Canada-West Indies Trade Agreement. Canada would take all the tomatoes Bermuda could ever grow and large quantities of carrots, cabbages and celery. Some of the difficulties mentioned were ineffective labour, the little use made of agricultural implements, the lack of education amongst the farmers, and the system of land tenure (75 per cent. of the farmers being tenants). Although the quality of vegetables produced was high, improvement was needed in methods of packing and grading.

Appended below will be found a table showing quantities (in bushels) of certain of the vegetables exported from Bermuda during the last four years.

Year.	*Carrots.*	*Celery.*	*Kale.*	*Onions.*	*Potatoes.*	*Tomatoes.*	*Totals.*
1926	68,996	74,572	28,599	39,336	91,933	3,081	306,517
1927	44,833	109,302	23,319	19,930	96,192	5,294	298,870
1928	42,250	129,266	41,481	16,063	110,136	1,584	340,780
1929	7,994	155,894	24,156	4,055	97,874	8,051	298,024

G. G.

THE CANARY BANANA.

Banana Cultivation in the Canaries.

By E. Holmes, Ph.D., A.I.C.
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[*Of the large banana producing areas of the world the Canary group is the only region in which intensive cultivation is practised and large quantities of fertilizers are applied to bananas on a commercial scale. Not only does every cultivator of commercial fruit use fertilizers but he uses a complete mixture. Apart from such general statements, however, little precise information is available in the agricultural literature regarding methods of cultivation, soils, and the composition and method of application of fertilizers used there. The following information was collected by the writer during a tour, made in* 1929, *under the auspices of Imperial Chemical Industries, Ltd., of the main banana producing districts of Teneriffe, Grand Canary and Palma.*]

Introduction.

The Canaries comprise a series of islands in the Atlantic Ocean, about 60 miles West of the African Coast, between 27° 40′ and 29° 30′ N., and between 13° 20′ and 18° 10′ W. The area of the islands is 2,810 square miles, and they form a rough semi-circle with its convex side facing southwards. They include Teneriffe, Grand Canary, Palma, Hierro and Gomera, which consist of isolated mountain peaks rising directly from an ocean of great depth, and Lanzarote, Fuerteventura and six uninhabited islands based on a submarine plateau.

The surface of the islands is formed chiefly of lofty dome-shaped heights, long, slightly articulated ridges, and deep volcanic cauldrons. Bleak level pumice-covered tracts alternate with green hilly spaces and broad troughs comparatively rich in soil or covered with artificial terraces; the whole is surrounded by lava slopes and intersected by deeply eroded, steep-sided radial ravines or *barrancos*, which form a characteristic feature of the islands. The lavas consist chiefly of trachytes and basalts, and the layers of volcanic material have formed, in combination with vegetable detritus, virgin soils of considerable fertility, and, though the virgin soil was generally shallow, decomposition in some parts has formed deposits of considerable thickness. There are now of course no virgin soils, but there is still much *malpais*, or unredeemed land, a wild chaos of sharp-edged lava masses, which might pay for working should irrigation water become available.

Climate.

The outstanding feature of the climate of the Canaries is the remarkably equable temperature at corresponding levels. Thus at sea level the mean annual range is only 11° to 14°F between the winter average of 61° to 63°F and the average of the hottest month (August) of 72° to 75°F. The temperature remains persistently high during the autumn.

Nearly all the rain falls during the winter; June, July, and August being practically rainless. Teneriffe (Guimar) has an average rainfall of 13.7 inches and Grand Canary (Las Palmas) 11.4 inches. The amount of cloud is somewhat high, and the fierceness of the sun's rays is tempered to an extent which renders the climate one of the most pleasant in the world.

The main agricultural feature of the Canary Islands is not so much the oft-quoted richness of the soil, as the extraordinary range of climatic conditions, due to variations in altitude, which make possible within a small area the cultivation of a wide range of crops. The land rises rapidly from the sea and within a few miles cultivation changes from: (*a*) bananas, tomatoes, oranges, lemons, date-palms, coffee and other tropical and sub-tropical crops (0 to 1,200 feet) to (*b*) the ordinary cultivations of Southern Europe including vines and cereals (1,300 to 2,800 feet) to (*c*) the indigenous trees, laurels, olives, &c. (up to 4,000 feet); to (*d*) the regions of the Canary pine (up to 6,400 feet); and finally to (*e*) the region of the white-flowering and sweet-scented broom (up to 11,000 feet on the Peak of Teneriffe which is just over 12,000 feet.)

Banana Areas.

The total area of the four banana producing islands of the Canaries (Teneriffe, Grand Canary, Palma and Gomera) is 1,500,000 acres, but only some 14,000 acres are under this crop. The principal banana producing areas are as follows:—

(1) The north coast of Teneriffe from Matanza to Garachico and Los Silos.
(2) The north coast of Grand Canary, Teldo and around Las Palmas.
(3) At Argual and Tazecorte in Palma, and
(4) In the districts of Valle Hermoso, Hermigua, and Agulo in Gomera.

Banana Soils.

The area of land at the lower altitudes in the Canaries having a deep natural soil is very restricted, and that having deep soil and sufficient moisture for cultivation of crops other than cereals is practically negligible. For banana and tomato cultivation made terraces are used almost exclusively, the depth of soil varying from 18 to 40 inches.

The soils in any given district vary from valley to valley, and even from terrace to terrace on the same farm. This is due to the fact that the soils are derived either naturally or by mechanical means from lava streams which have come down from the central mountain masses at varying periods during the history of the islands. Moreover many of the terraces have been made up with soil collected from various localities, in fact in some cases soil is being carried several miles from the sides of barrancos, to be used either for making terraces in districts supplied with irrigation water or for "topping" existing terraces not having a sufficient depth of soil.

THE CANARY BANANA.

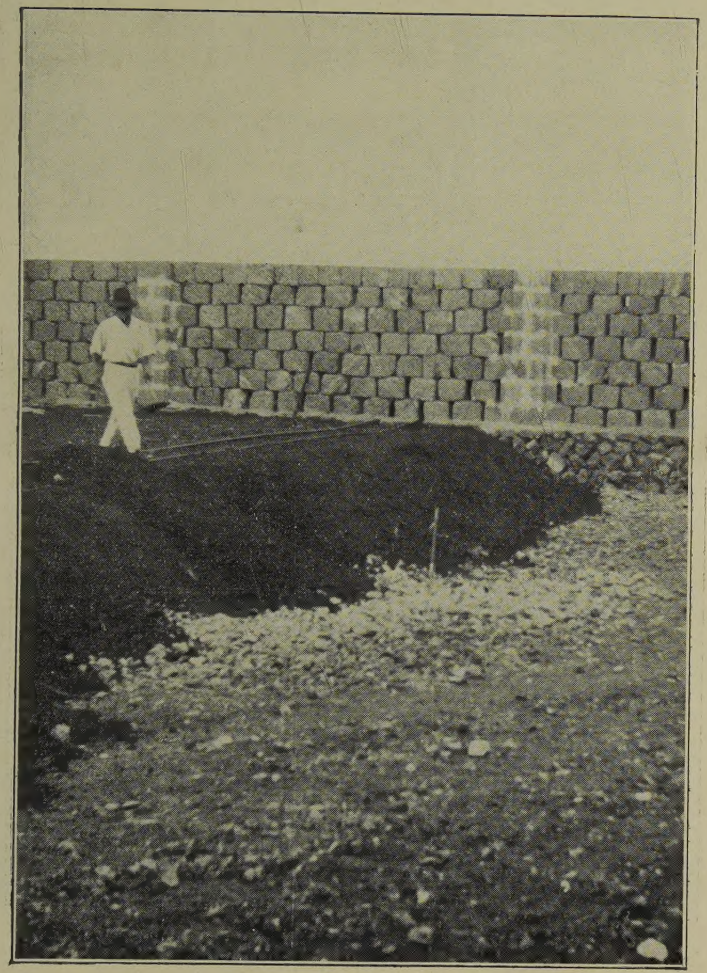

FIG. 1.—*An elaborate terrace with wall and wind-break in the course of construction.* (*Teneriffe.*)

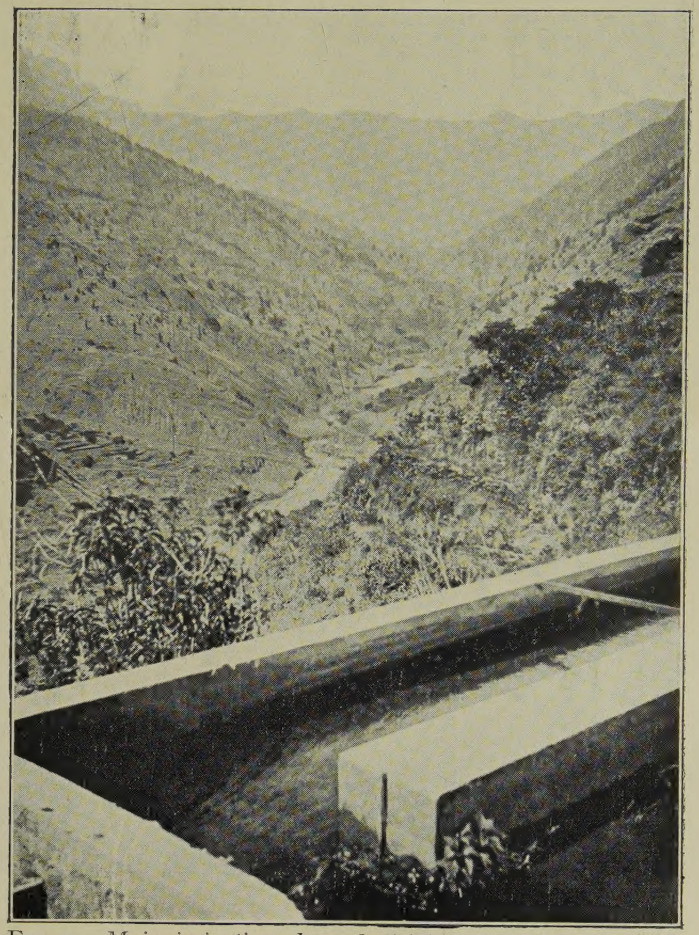

FIG. 2.—*Main irrigation channel with barranco in background.* (*Palma.*)

THE CANARY BANANA.

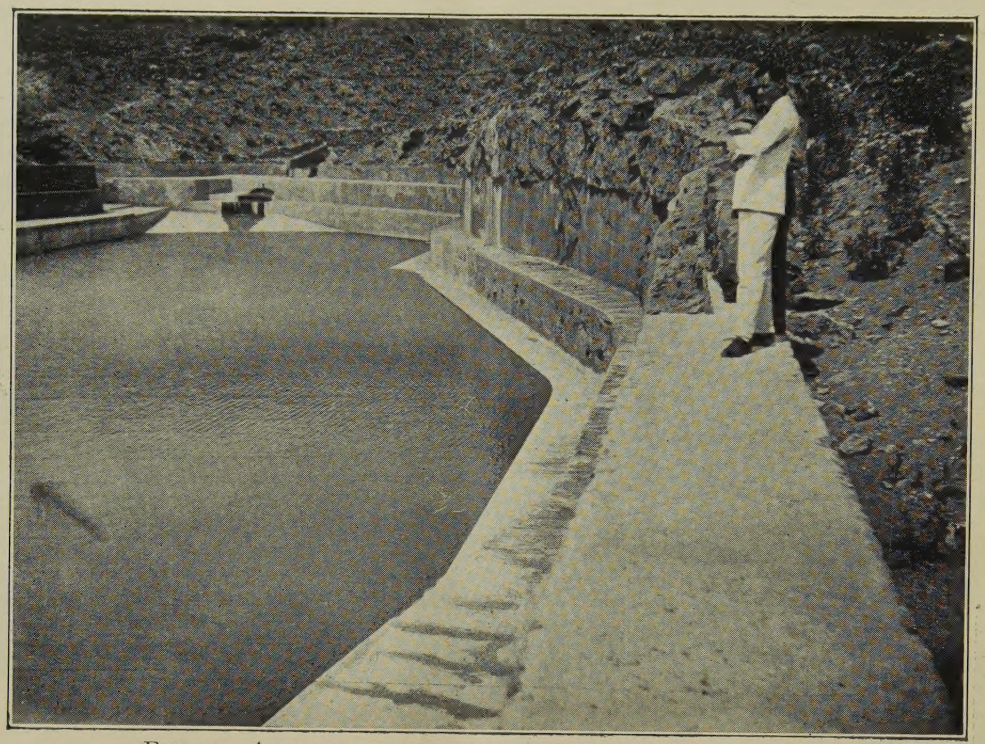

FIG. 3.—*A 25,000,000 gal. concrete irrigation tank. (Teneriffe.)*

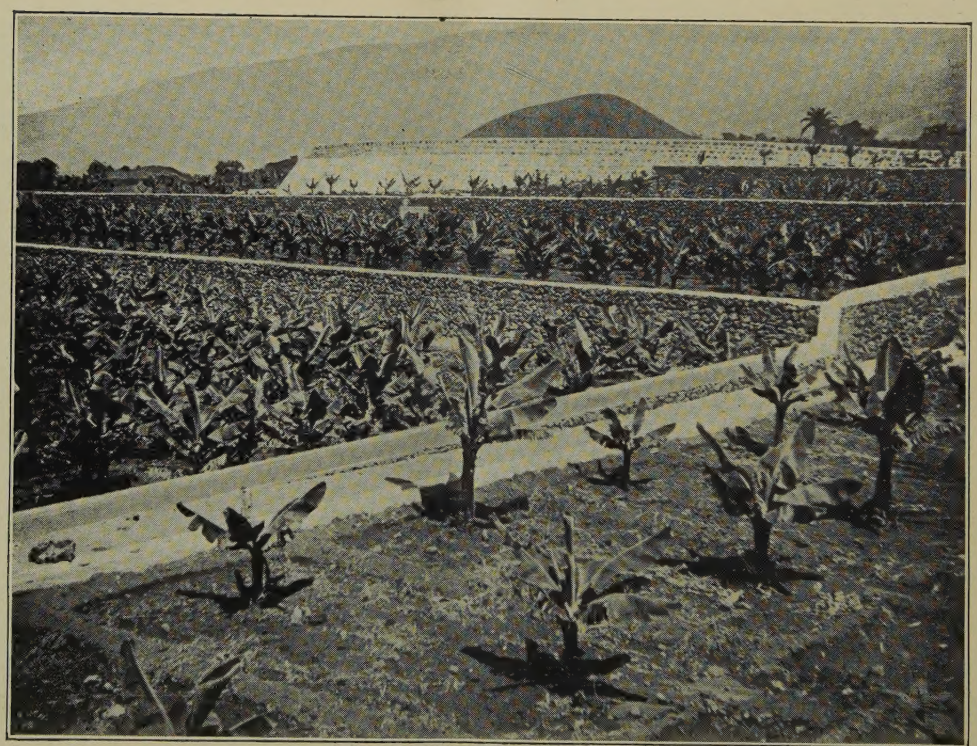

FIG. 4.—*Examples of good new terraces, with irrigation tank and volcanic cinder hill in background. (Teneriffe.)*

According to Don Rodolfo Godinez of the Agricultural Service, Santa Cruz, nearly all soils in the Canaries are lacking in lime. He has analysed a number of soils from Palma containing 0.3, 0.4, 0.5 and 0.7 per cent. of lime, only in occasional cases so much as 2.6 per cent. and he regarded two soils from San Sebastina in Gomera containing 3.8 and 6.0 per cent. of lime respectively as absolutely exceptional.

Tests made on several plantations with an ordinary pH indicator suggest that the banana soils are nearly all on the acid side, but subsequent laboratory work indicates that whilst they are lacking in lime the pH values are still high by reason of the sodium carbonate, probably provided by the saline irrigation water.

Banana Terraces.

A tremendous amount of labour is expended on the banana terraces, which are made on the sloping mountain sides, near the sea, at altitudes up to 1,100 feet. Usually a wedge-shaped section of rock and soil is removed from the site of the proposed terrace, the larger rocks are used for constructing the supporting walls at the lower edge of the terrace and at its ends, and in a few cases for constructing wind-breaks in exposed situations. Cane wind-breaks are used in some districts. The smaller stones are put back at the lower end of the terrace site to make the foundation level, and then the whole of the soil, sub-soil, and powdered rock which has been gleaned from the material removed is put back in a layer 18 to 40 inches deep.

The width of the terraces depends almost entirely upon the incline of the hillsides, becoming less as the hillside becomes steeper. Irrigation channels run along the tops of the main dividing walls between the various plantations and at right angles to these along the terraces, the water being distributed to pairs of individual plants by smaller concrete or masonry gullies.

It is obvious that many of the so-called banana lands are made up almost entirely of artificial soils, largely sub-soils and powdered rock, a fact which makes the cultivation of bananas more like pot culture than ordinary agricultural practice.

Irrigation.

Grand Canary is frequently stated to be best provided in respect of water supply, but owing to the driving of successful water galleries in Teneriffe, this island is probably now in the more favourable position. This is particularly true in the Orotava district and in the north of the island generally. The south-east, south, and south-west are still short of sufficient water for banana cultivation on a large scale. Quite recently large quantities of water have been tapped after many years of work in the Guimar district on the east of Teneriffe. Two large aqueducts have been constructed to carry these waters to the Tejina and Valle Guerra districts in the north of the island.

Grand Canary has springs of good potable water, and various mineral springs, notably that at Teror which provides a well-known table water, and many wells have been sunk. In Palma a large supply of good water obtained from four springs rising on the sides of the Calders or gigantic central depression on the island is supplemented by the rainfall.

The first impression on entering many plantations in the Canaries is that there is plenty of water, for the trickle of water can be heard on all sides. This, however, is an illusion since it only signifies that hard-won water is being used constantly on some terrace or other.

Land in the *terrenos de secano*, or non-irrigated districts, varies enormously in value; in the *terrenos de riego*, or irrigable districts, banana land in production with adequate water rights may be worth up to £1,500 and even £3,000 per fanegada (1⅓ acres approx*).

Gallery Water.

As has been stated the main sources of irrigation water in Teneriffe are galleries, which are cut into the sides of the mountains. Such galleries are cut by share companies or associations in which the shareholders subscribe something like five pesetas a month for each share they hold. If and when water is struck the amount available is very carefully divided up among the shareholders according to the number of their shares. Usually the water is allowed to flow over a metal knife edge divided into a series of fractions which are then apportioned out on a time basis, *e.g.*, a man holding a one-hundredth share in a gallery will be allowed the whole of the water coming over a tenth of the knife edge for 24 hours once every ten days.

Water is sold at prices varying with the locality, the time of year, and the seasonal climate. In July, 1929, water was selling in the Valley of Orotava, a district more than usually well supplied with water, at some 25 centimes a pipe, or 1¾*d.* per 110 gallons, the exchange then being £1 = 34 pesetas.

Well Water.

In Grand Canary large quantities of well-water are pumped for irrigation purposes, either by wind, steam or motor power. Owing to the volcanic formation of the islands it is impossible to predict the level at which water will be found, and very frequently wells are sunk unsuccessfully to a very great depth almost alongside prolific shallow wells. Much of the water in Grand Canary is brackish and more suited to tomato than banana cultivation.

Barranco Water.

Radiating from the mountains in each of the main islands is a series of steep, rugged barrancos which in the short rainy season become roaring

* The fanegada varies from 1·29 to 1·36 acres in the different islands.

torrents. In many parts of the islands large tanks either of masonry or concrete are constructed in the barrancos so that during the rainy season stores of water may be accumulated for future use.

When water is available at levels lower than the plantations, steam, wind, petrol or oil engines are used, usually in conjunction with rotary lift pumps, to elevate the water to the required level. Other and more primitive means of lifting water are used on the very small farms, *e.g.*, at one place near Argual in Palma two men were seen at work lifting water by hand from a main water channel to a height of about 15 feet to irrigate some two and a half acres of banana plantations. The method consisted of lifting water in a large calabash fixed on the end of an eight feet pole through a distance of seven or eight feet to a shallow trough, whence it was lifted in a similar manner to the requisite height.

The Use of Manures.

Organic Manures.

The banana soils already described contain little organic matter and receive comparatively little farmyard manure. Steers feeding on banana stems and a little straw are kept on some plantations, purely to provide organic material for these banana soils, but the actual amounts used are small. For example, enquiry showed that the actual amounts used in the Tazecorte and Argual districts of Palma were probably about 3,000 tons on 300 fanegadas, or 7.7 tons per acre. This material was of rather low value and probably one-third of the vegetable matter consisted of pine needles used as bedding material.

Artificial Fertilizers or Guanos.

All bananas grown for commercial purposes receive complete artificial fertilizers, and although fertilizer formulae vary somewhat at different times of the year and in different districts, on the whole there is a great similarity in the basic amounts of plant food in the mixtures.

The first application of fertilizer takes place in February and consists, when necessary, of approximately ¼ lb. of sodium nitrate per stool. This application is not absolutely general but is made where the plants appear to be lacking in vigorous vegetative growth after the winter months. The main fertilizer programme then begins in March and practically all planters apply fertilizers four times during the year, March to April, May to June, July to August, and September to October in amounts of one to two and a quarter lb. per stool. The mixtures applied are variations of the following which may be taken as a typical mixture :—

	Per cent.
Ammonium sulphate ..	50
Superphosphate (17 per cent. P_2O_5) ..	20
Potassium sulphate ..	30

This mixture contains 10.3 per cent. of N, 3.4 per cent. of P_2O_5 and 14.4 per cent. of K_2O. In addition to these materials, small quantities, from two to five per cent., of ferrous sulphate and calcium sulphate are frequently included in the mixtures. In general it may be said that the complete guanos used on bananas contain eight to ten per cent. of N, three to six per cent. of P_2O_5 and 11 to 15 per cent. of K_2O. In the past dried blood, fish meal, potassium nitrate, and bone superphosphate have been used, but owing to the cheaper unit price of the materials first mentioned these are now almost exclusively used.

The fertilizers are usually applied in two-thirds of a circle of radius two to three feet round the sucker and may or may not be hoed in before the subsequent irrigation.

The Banana Stool.

Propagation.

In the Canaries the banana plant is propagated almost entirely by means of old stumps or heads (*Cabezas*) of plants which have borne their bunch of bananas. Previously it was the practice to plant out the heads at wide spacings and to allow each stump to develop three or more suckers. Nowadays it is fairly general to plant stumps at three by four yards or four by four yards and to allow two suckers to develop per stool. The number of stools per fanegada varies from 1,000 to 1,200 and the number of exportable bunches from 650 to 1,000 per year.

Banana plantations receive on the average 1,500 pipes (each 110 gal.) of irrigation water per month per fanegada at 15 day intervals, equivalent to five and a half inches per month.

No cultivation of the soils in established banana terraces is attempted beyond cutting down weed growth and stirring just the surface. This may be carried out before irrigation, from two to six or eight times a year, and a small ridge is left round pairs of stools to facilitate irrigation.

One finds in almost every instance a complete "family" in each banana stool. First there is the old stump or grandmother (*Abuela*), which produced the previous bunch (if it has not been removed for planting out new areas), the present plant, or mother (*Madre*), which is producing the current bunch, and the young sucker (*Hijo*). Although the stools are laid out in lines when the plantation is first planted up, after a few years there is frequently no general order.

When the banana plant is 10 to 12 or anything up to 30 months old the growing point or embryo bunch appears from amongst the leaves of the plant and is then said to have been "born." This embryo develops quickly and within a comparatively short period the purple bracts covering the embryo "hands" of bananas curl up, blacken at the point of attachment to the stem and fall off. Soon after the bracts have

fallen off or been removed by hand to admit light and air to the fruit, each individual female flower is cut by hand from the tips of the immature fruits. The male flowers on the undeveloped and useless fingers at the lower end of the fruit stem are also removed, together with the purple bracts enclosing them as soon as the stalks have so far developed as to separate them by several inches from the fruits. As the bunch develops and becomes heavier a cane or other wooden strut is inserted between it and the main stem to support the bunch and prevent it from bending.

Growing Period.

As soon as possible after the inflorescence has emerged from the leaf stalks the number of the month is stamped on the stem to facilitate estimating the date of maturing of the bunch during the subsequent stages. The bunch of fruit is ready for cutting from four to eight months after its birth, but the total actual growing-period varies enormously in plants of the same variety. In this connection it is of interest to give details of an examination of the growing period of bananas as carried out in the Orotava Valley, Teneriffe. Forty-six plants, the suckers of which appeared at known times between March, 1925 and February, 1926 were examined by a well-known planter for the total time until the birth of the bunch, and for the number of hands on the resulting bunches. It was found that this growing-period varied from 17 to 30 months and there was practically no correlation between date of appearance of sucker, time until birth, or the number of hands per bunch. These facts indicated considerable physiological differences between individual plants in a single plantation of the same variety of bananas, and immediately suggested a line of work which so far as the writer is aware, had not been attempted in the islands. If a definitely short or long growing-period is a strain characteristic of the sucker from a given banana stool of the Cavendish variety, then it should be possible gradually to select for planting heads from stools characterised by the short growing-period of their suckers. Since it is impossible to propagate commercial varieties of bananas by seed or in any other manner which can give a large number of plants from a single individual quickly, it would take some time to obtain a plantation of short-growing period bananas. Even, however, if the average time from the appearance of sucker to the birth of the bunch in this district were reduced from say 24 to only 20, and the total time to maturity of the bunch, say 29 to 24 months, the resulting increase of some 21 per cent. in the number of exportable bunches per year would be a distinct economic advantage. An investigation along these lines is now in progress.

Time and Method of Harvesting.

The week before the mature bunch is removed from the plant most of the crown leaves are cut away and the bunch marked for the actual cutter. The number of cuttable bunches per fanegada varies enormously in the different districts, as also does the average weight per bunch. As an example, however, it may be stated that on a set of good average plantations of a total area of 398 fanegadas 294,353 bunches weighing over 22 lb. each were cut in 1927, whilst on 360 fanegadas, 330,927 bunches were cut in 1928. The average numbers of exportable bunches in these two years were 739 and 919 per fanegada respectively.

The biggest fruit is "born" in July to December and cut, generally speaking between December and June, although the period between "birth" and cutting varies considerably between high and low lands, and between the hotter and cooler zones. In Tazecorte, Palma, for instance, fruit is cut at least two months before that at Orotava, Teneriffe, levels being equal. In general, bunches of fruit of the best classifications, *i.e.*, the biggest uniform bunches, are cut in May and June, but most fruit is usually shipped from June to September. Bunches "born" in summer, especially July bunches, usually consist of abnormally long stems with gaps between the hands; winter bunches are more compact.

A curious phenomenon occurs with what is known as a "May" bunch. Bunches of fruit "born" in May invariably become irregular bunches of mediocre fruit. The fingers stand out at all angles, and are quite different from the orderly hands on a good exportable bunch. It is supposed that the embryo bunches of such fruit are at a critical stage, low down in the plant "stem," when spring growth starts, and the sudden impetus to growth upsets the symmetry of the bunch. Work on this phenomenon and its possible prevention appears desirable. Such fruit is all sold locally.

That bunches of fruit of the same classification, *i.e.*, of the same weight, vary considerably among themselves is evident from an interesting examination carried out in Teneriffe by a planter in November, 1924. He took 100 bunches all weighing 44 lb. and all measuring for the English Extra Medium Grade. None was less than eight hands, none over 11 hands, but the fingers per hand varied between eight and 36. The total number of fingers was 16,030 on 912 hands, or an average of 9.12 hands per bunch and 17.57 fingers per hand.

In 1928 a record bunch was produced in Palma weighing 132 lb. and having 360 individual fingers. It would probably have weighed 143 lb. at full maturity, but was cut rather early to avoid the possibility of wind damage, and fetched £50 in London for charity. The average weight of an exportable bunch is 44 lb. and some planters consider it unprofitable to add extra "guano" to produce bunches over 66 lb. The minimum weight for an exportable bunch is 22 lb.

Costs of Production.

It is stated to cost, on an average, £120 to £150 per fanegada to establish a plantation and pay a rent of say £15 in the first year, without taking into account terracing or provision of water. In Grand Canary in 1929 it was said to have cost £26 for irrigation per month per fanegada instead of the usual £14 10s. owing to shortage of water. When the plantation is in production, and, of course, provided with water, it will be worth a rent of £100, £120, and up to £200 per fanegada according as it is on poor, normal or excellent soil, or sell for £1,500 to £3,000 in the open market as already stated. The actual total cost of producing an exportable bunch, averaging all grades, may be taken as 3.80 pesetas, or rather less than 2*s*. 3*d*., at an exchange rate of £1 = 34 pesetas, not counting packing costs. Labour costs including cultivation and gathering of fruit average possibly £23 per fanegada for bananas as compared with £45 for tomatoes. This, of course, refers to areas where labour is paid for at about 1*s*. 6*d*. to 2*s*. for women and 3*s*. 6*d*. a day for men.

Although relatively high profits are made from banana cultivation one of the most disturbing factors is the incidence of severe wind storms from time to time.

Packing of Bananas for Export.

The Cavendish banana does not carry so well as the ordinary Gros Michel and all bananas leaving the Canaries are packed either in straw, in wooden stave crates, or in paper and straw in cardboard drums. This packing is usually carried out by the shipping companies who buy the fruit from the farmers on a weight basis, depending upon the market and upon the grade of fruit. In the last four years the prices per kg. (2.2 lb.) of fruit realised by farmers for bananas in Teneriffe have varied from 25 to 55 centimos per kg. for bunches of 10 to 14 kg. (22 to 31 lb.) up to 50 to 75 centimos per kg. for bunches of 18 kg. (40 lb.) upwards. (A centimo = $\frac{1}{100}$ of 7*d*. in the summer of 1929).

Some of the fruit-shipping companies either own or rent comparatively large areas of bananas, but in addition there are two Spanish co-operative syndicates, one in Teneriffe and one in Grand Canary, which pack and ship fruit for their members. In these cases the farmers realize a slightly higher price for their fruit than those farmers selling to the usual shipping companies.

The following table indicates the number of crates of bananas containing from one to four or five bunches per crate, shipped from the Canaries during 1926, 1927, 1928 and 1929, together with their destination by countries.

Recent Exports of Bananas from the Canaries.

Destination.	Bananas (Crates containing 1 to 4 or 5 bunches).			
	1926.	1927.	1928.	1929.
	000's	000's	000's	000's
United Kingdom ..	2,354	1,573	1,435	1,080
France	871	1,005	1,336	1,319
Spain	602	647	649	743
Germany ..	705	616	625	549
Holland ..	15	7	—	—
Denmark ..	17	13	7	1
Norway	2	4	5	1
Belgium ..	—	—	6	77
Italy	71	22	—	—
Greece	—	—	—	1
Africa	—	3	2	4
Total Crates ..	4,637	3,890	4,065	3,775
Total Bunches (Estimated) (*a*) ..	10,400	8,750	9,150	8,500

(*a*) Estimated at an average of 2¼ bunches per crate. There has been a tendency for this ratio to rise in recent years, particularly for fruit going to the European countries, but not to the United Kingdom.

Banana Diseases and Pests in the Canaries.

Panama disease.

In the last ten years some considerable concern has been felt regarding the occurrence and limited spread of a particular fungus disease in banana plantations, especially in the Orotava Valley of Teneriffe. Plants suffering from this disease have been examined from time to time in England and the view now held is that the disease is caused by a *Fusarium* which is extraordinarily like *F. cubense*, but which cannot be positively identified as such. If as seems probable, this is Panama disease, then it is a mild form of the fungus induced by the comparatively dry climate of the Canaries and by the largely open nature of the soils. Incidentally the farm on which most of the disease has occurred has been one on which the soils on the terraces are rather shallow and overlay an impervious *tosca* rock.

This disease is not of much economic significance in the Canaries as compared with the West Indies. It is being treated by removal of the affected plants, in some cases followed by burning of plant and trash, and by heavy liming of the soils affected.

Finger-tip rot.

"Cigar-end" or "Finger-tip rot" of bananas caused by *Verticellum stapylidium* needs constant attention. The fungus first attacks the dead female flowers, and if these are not removed the fungus passes into the fingers and causes a decay. The trouble is avoided by cutting off the female flowers when the fruit is very small, the work being carried out by children. In some districts of Grand Canary this troublesome practice is not necessary.

Insect pests.

In 1924, Professor R. Stewart MacDougall carried out what he called a quick entomological survey of the Canaries, in the course of which he examined and subsequently described, four

insect pests of economic importance in the banana plantations. Two of these, a red spider (*Tetranychus*) and a thrips, were considered to be of small importance. The red spider is known locally as the "red bug," the popular name being *aranillos* or little spiders, and the mites are found on the fruits, which show a paleness and discoloration characteristic of plant tissues wounded by the mouth parts of the red spider. The thrips, known locally as the "black bug," also cause a paleness and discoloration of the attacked fruit. Both are known to the Spanish workers as *bicho blanco*, the animal which causes whiteness.

The other two enemies are much more serious, one a scale insect, *Pseudococcus Comstockii*, Kuw., described by McDougall (*Bull. Ent. Res.*, 1926, No. 17, pp. 85 to 90), and a moth, the banana miner, *Hieroxestis subcervinella*, Walk., described by J. N. Oldham (*ibid*, 1928, No. 19, pp. 147 to 166).

The scale insect mentioned is known locally as the cochineal insect, not, however, the true cochineal dye insect. It is found on all the above-ground parts of the banana plant and the drainage of sap from the plant by the feeding of hundreds of these insects results in the lowering of fruit and vegetative output.

Early attempts to control the pest consisted in wiping the insects off the plants, but nowadays the fruit is sprayed with water at fairly high pressure or with a crude lubricating oil-soft soap emulsion, whilst the Argentine ant, *Iridomyrmex humilis*, Mayr., which to a large extent farms the scale insect, is now being controlled by means of sugar and sodium arsenite bait.

This mixture, which is rather viscous, is applied 1 or 2 cc. at a time to a small section of banana leaf or stalk which is placed at the base of each banana plant. A few minutes after application, the edge of the pool of material is fringed with ants busily feeding; as a rule no dead ants are to be seen. The poison is intentionally made sufficiently dilute to allow the ant to gorge himself and still be capable of returning to the nest. Here it dies of slow poisoning, its body is eaten by other ants, who, in turn die of still slower poisoning, and so on. The result is that, whereas a few years ago many plantations both in the islands of Teneriffe and Palma were literally white with the *Pseudococcus* pest, it is now sometimes difficult to find specimens of the insect.

The second insect pest of serious economic importance, the moth, *Hieroxestis subcervinella*, Walk. although not observed by workers in 1922 was shortly afterwards found in practically all plantations. The caterpillars are voracious feeders and construct long, meandering galleries of which the large conspicuous entrance and exit holes show on the outside of the affected parts of the banana plant.

Methods of control consist mainly in the removal of the female flowers from the fruit fingers and in the treatment of the tops of the banana stumps following the removal of the fruit bunch and stem, with quicklime.

COFFEE IN FRENCH COLONIES.

FRANCE is one of the largest consumers of coffee in the world, ranking second in the list of importing countries. According to recent statistics, however, the French colonies produce less than three per cent. of the total coffee consumption in France. In 1927, France imported 159,000 tons of coffee, of which her colonies furnished 4,487 tons or only 2.82 per cent. of the entire amount consumed. In the seventies the French West Indies (Guadeloupe, Martinique and Reunion) supplied the world with excellent coffee but after a time many of the coffee trees in these colonies were destroyed by cryptogamic maladies and the industry was completely wiped out. It also gave way to the cultivation of sugar-cane. France at present consumes more than 12 per cent. of the world's production of coffee, most of the coffee imported coming from Brazil.

During recent years Madagascar, French Equatorial Africa, Indo-China and New Caledonia have taken up the cultivation of coffee. The principal plantations in Madagascar have been started on the East Coast of this colony and the varieties known as *Kouilou* and *Congo*, as well as *Robusta* are being grown. In 1927, Madagascar exported over five million kilograms of coffee. In French Equatorial Africa coffee growing is still in the experimental stage but apart from the local consumption, which is said to be very high, this part of the world exported about 58,000 kilograms in 1927. Besides encouraging native production, attempts have been made to attract foreign capital to produce coffee along commercial lines. In Indo-China all varieties of coffee are grown and the territory devoted to coffee is being enlarged each year. In 1926 New Caledonia exported 644,455 kilograms of *Arabica* and *Robusta* and by 1927 this figure had been increased to 809,403 kilograms. Everything possible is being done to encourage coffee production in this colony.

Much important work is being done by the National Institute of Colonial Agronomy, at Nogent-sur-Marne, and by men like Auguste Chevalier, so that those engaging in the planting of coffee in the colonies will be assured of remunerative yields within the shortest possible time. On the Ivory Coast coffee trees are being distributed gratis to the natives, and during the first six months of 1928 some 75,000 plants were taken from the station at Niaouli, Dahomey. French Guinea is attempting to equal this effort and even go beyond it. It will be seen that considerable development with regard to coffee production may be expected in the French colonies in the next few years. If, also, the tariffs on foreign coffees should be raised in France, this development should be greatly accelerated.—(Abstracted from "Coffee in the French Colonies" by O. C. Zilisch. *The Spice Mill*, Vol. LIII, No. 7.)

G.G.

COTTON PRICES.

Supplies and Consumption.

By John A. Todd, M.A., B.L.

In a recent article, "Sea Island Cotton" (Vol. 7, No. 7, page 190, July, 1930) the writer outlined the recent developments in connection with the demand for Sea Island Cotton which had apparently given ground for some hope for better times. Since then, however, cotton in general has once more passed under the cloud of very severe depression and as this inevitably affects Sea Island Cotton as well as other kinds it may be of interest to the readers of *Tropical Agriculture* to know what has happened and as far as possible why.

It must of course always be kept in view that cotton is essentially a world market and although the world's supply may be divided into fairly distinct categories, *e.g.*, Sea Island, Egyptian, American, Indian, &c., the prices of all these varieties are closely related to each other and all of them are more or less dominated by the conditions affecting the price of American cotton which still accounts for well over 50 per cent. of the whole supply. The India-China-Russia group is the next largest in quantity, amounting altogether to more than half of the American crop in a normal year, but their influence on prices is comparatively small. The Egyptian crop, amounting to about ten per cent. of the American in quantity, is far more important having to a certain extent a market of its own; and the Sea Island crop though entirely insignificant in quantity is of course of very special importance on account of its high quality.

Now the conditions which have produced the recent slump in cotton may be classified as, in the first place, world conditions which have affected the general level of prices in nearly all countries and particularly the prices of raw materials. This general slump may most conveniently be described as beginning with the Wall Street crash in October, 1929, though as a matter of fact, it is practically certain that that in itself was merely one result, and not necessarily the first, of a crisis in general conditions, largely monetary. In the first place it affected most directly the prices of Stock Exchange securities of all kinds, but its extension to all staple commodities was inevitable.

But the fall in cotton prices has been more severe than that of other staple commodities and the reasons for this are rather difficult to explain. Paradoxical as it may seem, they may be found largely in the very fact that the two governments chiefly concerned, the American and the Egyptian, embarked on schemes which were intended to maintain the price of cotton, but which so far seem on balance rather to have had the opposite effect.

To explain this it is necessary to go back some years in the history of American politics. There has for long been a growing feeling that the farmers in America have been very badly used by the State, because they suffer very severely from the effects of high tariffs which raise their cost of living but in no way benefit the prices of their products. The feeling has therefore been growing that the Government must do something for the farmers, and the McNary-Haugen Bill of 1927 was an attempt to work out a scheme for this purpose. It was probably conceived in terms of wheat though it applied also to cotton, hogs and other products; and the idea of it was that when owing to large production in any one season there was a surplus unsaleable in the United States, the government should take over the marketing of the exportable surplus, selling if necessary at a loss and spreading that loss in some way over the whole trade. Nothing came of this Bill, but in the last presidential election the Republican party had to promise again to do something for the farmer, and the result was the Agricultural Marketing Act and the subsequent formation of the Federal Farm Relief Board in the summer of 1929. The activities of this Board have so far been mainly directly to wheat and cotton, but our description will of necessity be confined largely to their application to cotton.

Their policy was from the first to assist the farmers not directly as individuals but through some representative organisation, and the only thing of the kind in cotton was the Co-operative Associations which had been working for some ten years, but which it must be admitted had so far not succeeded in attracting more than about five per cent. of the cotton farmers into their ranks. The first action of the Federal Farm Relief Board was to call on the Co-operatives to get together and form a central organisation representing them all, for though such a central body already existed it was not complete. Then about the middle of October the Farm Relief Board announced that they would put the Co-operatives in a position to lend to their members on the basis of a price of 16 cents for Middling, Spot prices being then about 18 cents. This came very opportunely, because owing to the extraordinarily rapid movement of the crop in the early months of last season the weight of hedge selling had begun to depress the market unduly, as it was thought, and this promise of government assistance at once checked the fall. Unfortunately, however, this was immediately followed by the Wall Street crash; but for a time the hope of government assistance did enable cotton to withstand the crash rather better than it would otherwise have done, and until January cotton prices held fairly steady. But towards the end of that month there came a very curious development which can only be described as largely psychological. It seemed as if the market suddenly got tired, and with

one accord most of the "longs" who had been holding on to their cotton through the decline began to let go. The result was a rapid and very serious decline which ultimately carried prices down nearly 3*d*. a lb. In ordinary course this would soon have worked itself out, but before it had time to do so it revealed a very extraordinary situation. It turned out that the Co-operatives, in addition to holding large quantities of actual cotton, had been buying futures pretty heavily, against sales of actual cotton which they had had to let go earlier in the decline at prices then regarded as unsatisfactory; in effect they had exchanged the actual cotton for futures in the hope of getting back their loss when the market recovered. In the meantime, however, they had to meet differences on these futures as the decline went further, and it soon became known that some of them at least were unable to do so. As the government had built their whole system of relief on the Co-operatives they could not afford to let them go bankrupt and in February they announced that they would support the Co-operatives in taking up these futures; in other words that they would become responsible for the differences.

The next stage was when it became known in the market that the Co-operatives would take up these futures when they matured in May or July, and this produced an extraordinary situation. The merchants and speculators who had sold these futures realised that they must either buy them in or deliver the cotton. The largest spot house in America (and incidentally in the world), was chiefly concerned in this and they took the course of delivering the cotton. To do so they had to raise every available bale, including not only tenderable cotton in the American sense of the word, *i.e.*, cotton which is no better than seven-eighths inch in staple, but also a great deal of cotton of better staple which if sold on the spot market would command a good premium, but if tendered under contract would realise very little more than the minimum tenderable quality. This of course involved them in huge losses, and it also had the inevitable effect of immediately raising the price of futures practically to the level of the government's figure of about 16 cents.

But these futures were only in the near months, mostly May and July, with the result that while these near months recovered, the distant months, *i.e.*, new crop months, were not affected at all and remained at about the level to which they had fallen. The result was to create a very heavy premium on the near months, or discount on the distant months. This is an abnormal state of affairs and had the inevitable effect. The demand for actual cotton was immediately checked, because potential consumers saw that by waiting for the new crop they would get the cotton very much cheaper; and this contributed in no small measure to the complete strangulation of the demand for actual cotton which marked the latter half of the season. Other causes of course were working in the same direction. The depression which affected everyone in America naturally led to a considerable decrease of actual consumption of cotton goods. The mills, having in previous depressions been badly caught with heavy over-production on a falling demand, quickly took steps to avoid this happening again, and the manufacturing schedules of the American industry were cut down all round to a very low figure. The result of course was that stocks of raw cotton mounted up, and at the end of the season, as it now turns out, the world's Carryover of American cotton was about 6,150,000 bales excluding linters, an increase of nearly 2,000,000 bales on the figure of a year ago.

As part of their scheme for assisting the cotton trade the Federal Farm Relief Board stipulated for a definite policy of restriction of acreage in 1930, and a figure of 40,000,000 acres as against 47,067,000 last year was spoken of as the ideal. The market was from the first very sceptical of the success of this movement, believing that the growers, relying on government assistance would again plant a substantial acreage, and as this conviction grew, and with favourable weather in the early months of the season it seemed probable that the 1930 crop would again be large, another wave of selling broke over the market in June, which once more carried prices to a new low level for the season.

In the meantime the Egyptian Government had adopted a somewhat similar policy but with different methods. They took the direct course of taking up tenders on the market at fixed prices, and as these prices were more than could be obtained for actual cotton the result was that large quantities of cotton were tendered to the Government, and at the end of the season they had accumulated a total, including the remains of their purchases in former years, of well over 3,000,000 kantars, or fully half of the total world's Carryover. Here, again, the effect on actual consumption was the same. Spinners, believing that they would get cotton cheaper by waiting, held off the market and consumption rapidly declined, with the result that the Carryover at the end of the season was by far the largest ever known, and indeed was very nearly as large as it had been at mid-season, which of course is unprecedented. The result was that in the Egyptian market, as to a certain extent in the American, there were practically two prices for cotton, the one in Alexandria being the government's fixed price which of course only applied to near months, and the other for what might be called free cotton, *i.e.*, the distant months in Alexandria and more or less all months in Liverpool.

This, however, produced another reaction. The prices of all kinds of outside growths were of course unaffected by the Government action in America and Egypt, and all of those which normally compete with American and Egyptian

quickly followed the decline in American. The result was that the price of such growths as Tanguis (Peruvian), East African, Brazilian, Argentine, &c., fell far below the more or less controlled prices of Egyptian, with the result of course that the tendency which had been evident for some time to use these other growths in place of Egyptian, as well as in place of American, was greatly accentuated and this still further restricted the consumption of Egyptian cotton.

The result was seen at the close of the season when the publication of the Federation's statistics completed the figures of the World's Consumption and stocks. The consumption of American had fallen to extraordinarily low figures, but this was largely offset by an unprecedented figure for the consumption of Outside Growths (except Egyptian). The result was that for the first time in history the world's consumption of Outside Growths during the second half of the season was actually larger than that of American.*

The following table summarises the World's Consumption figures by varieties since the war with pre-war figures for comparison.

World's Consumption—American v. Outside Growths.

RUNNING BALES—000's. EXCLUDING LINTERS.

Season.	World's Total.	American.	Outside Growths.				
			Indian.	Egyptian.	Sundries.	Total.	Percentage on American.
1912-13 ..	22,967	14,153	3,941	936	3,937	8,814	62.3
1919-20 ..	19,011	12,339	3,710	854	2,108	6,672	54.1
1920-21 ..	17,916	10,003	4,570	514	2,829	7,913	78.9
1921-22 ..	21,109	12,728	4,922	742	2,717	8,381	65.8
1922-23 ..	22,043	12,594	5,382	890	3,177	9,449	75.0
1923-24 ..	20,396	11,080	5,404	1,027	2,885	9,316	84.1
1924-25 ..	23,309	13,270	5,521	971	3,547	10,039	75.7
1925-26 ..	24,686	13,736	5,572	920	4,458	10,950	79.7
1926-27 ..	26,139	15,777	5,196	994	4,172	10,362	65.7
1927-28 ..	25,541	15,407	4,523	957	4,654	10,134	65.8
1928-29 ..	25,872	15,066	5,178	989	4,639	10,806	71.7
1929-30 ..	25,209	13,023	6,087	937	5,162	12,186	93.6
1st Half ..	13,202	7,083	2,985	502	2,632	6,119	86.4
2nd Half ..	12,007	5,940	3,102	435	2,530	6,067	102.1

With the opening of the new season the next phase of the situation began to develop. In July it became known that the American acreage had only been reduced by 2.7 per cent. leaving 45,815,000 acres planted and it was evident that such an acreage with average luck in the weather would produce a substantial crop; 15,000,000 bales seemed quite probable, and it might easily be more. Very soon after this, however, doubts began to be felt as to the progress of the crop. The winter season had been good, with heavy frosts to kill the weevil, and the spring brought good weather on the whole, which indeed by May began almost to threaten a drought in certain parts of the Belt. That broke, however, and there were ample rains in May which again ended just in time to let chopping be carried out

* The Federation figures are of course in running bales. If it were possible to convert them all into equal bales the result might be slightly different but it would not alter the general effect.

under ideal conditions. But a hot dry spell which began about 20th June assumed in July the threatening aspect of a drought which covered nearly three-quarters of the whole Belt; and before the first report of the season was due on 8th August really alarming reports were being received as to the effects on the cotton crop.

What would, however, in ordinary times have amounted to a real crop scare fell entirely flat because in view of the restriction of consumption, which had not been equalled since the period of virtual famine of American cotton in 1923-24, and the huge Carryover looming ahead, the market seemed almost relieved at the prospect of a comparative crop failure. When therefore the Government Bureau of 8th August came out with an indicated crop of 14,362,000 bales, the market instead of being relieved was acutely disappointed, and prices once more fell to new low levels for the season. The drought, however, continued throughout the most of August, and as the September report drew near everyone expected that it would show a marked reduction from the August figure; but when this again proved unfounded and the Bureau's figure of 14,340,000 bales showed practically no reduction at all, the market once more had an acute fit of indigestion and for a day or two prices went lower than ever. A month later the October Bureau confirmed this by raising the figure to 14,486,000 bales, the drought having broken in the meantime.

In regard to Egyptian the situation is something similar. The acreage this year showed an increase of 13 per cent. to 2,082,420 feddans against the previous record of 1,924,000 feddans in 1925; and as the increase is largely in Upper Egypt while even in the Delta there was an increase of Upper Egyptian varieties which have a much heavier yield than Sakel, the prospects were that the yield this year would easily reach 9,000,000 kantars. Since then, however, unfavourable developments have reduced current estimates to about 8,750,000 kantars and the first Government estimate is only 8,420,435 kantars.

With prospective supplies so large it was inevitable that prices should go to low levels, but an examination of the statistics of supply and prices raises considerable doubt whether the actual levels are justified.

The necessary statistics are given in the following table.

American and Egyptian Crops. Seasons' Supply and Prices.

American (Running bales 000's.) ex linters.					Egyptian (Kantars 000's).				Index numbers Wholesale prices (Bd. of Trade).	
Season.	Carryover beginning of season.	Crop.	Seasons Supply.	Seasons Average Spot price Liverpool.	Carryover beginning of season.	Crop.	Seasons Supply.	Seasons Average Spot price Liverpool.	Year.	Percentage on 1900.
				Pence per lb.				Pence per lb.		
1920-21	5,656	13,271	18,927	11.89	3,612	6,030	9,642	30.24	1920	365.7
1921-22	9,141	7,978	17,119	11.37	4,484	4,858	9,342	19.75	1921	229.7
1922-23	5,028	9,729	14,757	14.92	4,485	6,213	10,698	17.29	1922	185.0
1923-24	3,235	10,171	13,406	17.66	3,996	6,531	10,527	21.55	1923	185.1
1924-25	2,665	13,639	16,304	13.76	2,349	7,274	9,623	29.82	1924	193.6
1925-26	3,324	16,123	19,447	10.77	2,222	7,965	10,187	20.05	1925	185.3
1926-27	5,358	17,755	23,113	8.15	3,658	8,635	12,293	15.39	1926	172.5
1927-28	7,474	12,783	20,267	11.17	4,712	6,097	10,809	19.39	1927	164.7
1928-29	4,952	14,297	19,249	10.52	3,573	8,012	11,585	18.14	1928	163.4
1929-30	4,332	14,548	18,880	9.09	4,243	**8,400**	12,643	14,52	1929	158.9
1930-31	**6,108**	**14,486**	**20,592**	—	6,131	**8,750**	**14,881**	—	1930	**140**

Estimates in black type.

In the case of American it will be seen that while the season's average prices usually follow the tendency of the season's total supply, *i.e.*, crop plus Carryover, for the last two seasons the price of American has persistently refused to rise to the level indicated by the reduced supplies.

Many reasons have been given for this, but they are all closely related to the facts of the consumption already explained. The truth is that the drought in Texas in 1929 brought to a head a movement which has been threatening the dominance of American cotton for some years. The quality of the American crop has deteriorated very markedly since the advent of the weevil which has compelled the growers to plant early maturing and therefore short staple cottons, in place of the older varieties, such as Texas 1⅛ inches staple cotton. This, and the steady increase of the world's supplies of Outside Growths including Indian has at last brought the inevitable result, and the world's spinners have gone over to an unprecedented extent from American to Outside Growths. As an illustration of the peculiar ways in which such things work it may be mentioned that this year American cotton in Europe had to face intense competition from a new source. Brazil produced in the southern district around Sao Paulo a considerable crop of cotton of American class which is normally consumed by the local mills; but last year that crop was unusually large and owing to a variety of causes, mostly financial, the local mills were unable to take it up, with the result that it was dumped on Liverpool and other markets where it proved very acceptable at the price. At the same time America is beginning to feel the competition of the rapidly recovering Russian crop, which last year was probably the largest since the war, and this year is certain to establish a new record by a long way. As Russia in recent years has been taking large quantities of American cotton which she no longer needs, this helped to intensify the effect on American.

Thus the deterioration of the American crop has proved to be the opportunity of all the others, and this has at last forced on the American growers the need for reform; but this year with the still wider drought it is doubtful whether the quality will show any improvement on last year; indeed so far as the staple districts in the Mississippi Valley are concerned it is almost certain that it will be worse, for last year that district escaped the drought.

The result is that the future prospects of cotton prices are very difficult to assess. The prospects of supply are pretty well known, but the whole problems lies in the demand. Will the consumption of American come back to something like normal under the stimulus of lower prices? Past experience certainly points that way, for cotton has always shown remarkable elasticity of demand, as for example after the bumper crop of 1926. Cotton prices as a whole are certainly low enough now to tempt increased consumption, for cotton is well below pre-war levels, and lower than other staple commodities. But the real question is whether in the course of the inevitable recovery American will come back to its former relative position, or whether Outside Growths will retain the improved position which has been so marked during the past season. Probably the best answer to that question is that it depends on the American crop. Most of the world's spinners really prefer American cotton if they can get it good and reasonably cheap. America herself of course uses practically nothing but American cotton, and the effect of the new seven cents tariff on long staple cotton will be if anything to discourage imports still further. But the recent restriction of consumption in America has been far too severe to last long, and already there are indications which give hope of an early recovery. It is not likely that America will soon recover to anything like the peak of her cotton spinning activity of say a year ago, but even a partial recovery in America alone would very quickly affect the world's total, even if that recovery were not fully shared by the rest of the world. There is very little doubt therefore that the world's consumption of American cotton during the coming season will be a good deal more than last year's figure of 13,023,000 bales, but whether it will rise as high as the probable crop of 1930, which for the present may be taken as 14,500,000 bales, is uncertain. But this year's crop will be little more than a normal year's consumption, and even with the large Carry-over the season's prospective supply is by no means overwhelming. If present low prices continue throughout the autumn they will certainly lead to a further reduction of acreage next year, and we shall have once more the old swing of the pendulum back to comparative scarcity and higher prices.

But in the case of Egyptian the position is very different. With a season's prospective supply of over two years consumption, and everything pointing to a still further increase of future crops, it is obvious that something must be done to increase the consumption. There is no question of the desirability of Egyptian cotton at a price, and the only question is what the price must be. At present Sakel and Uppers in Liverpool are still commanding premiums of nearly 60 per cent. and over 20 per cent. respectively, and this puts them entirely out of competition with other varieties such as Tanguis, which may not be as good but serve the purpose and are far better value at the price.*

Is it possible to draw from all this any moral for the cotton growers of the world, and especially of the Empire? Anything of the kind must be extremely tentative and must not be taken as extending beyond the immediate future, for things change very quickly in the cotton world. But this much may be risked; at present the world's supply of shorter cottons and inferior grades is suffering from an over supply. At the other extreme the supply of long staple cotton like Sakel is also very ample. The demand for Uppers and other cottons which approach it in quality such as Peruvian and East African

* Since this was written the premiums have fallen substantially, especially uppers.

is capable of greater expansion; but the one section of the trade especially in England which has had difficulty recently in meeting its requirements is that which used to rely on the good Texas cottons of what was called $1\frac{1}{8}$ inches staple. In recent years that has almost disappeared and they have had to search the world for substitutes with considerable but only partial success. Any country that could produce just that class of cotton in moderate quantities would probably find a very ready market, as long as conditions in Texas remain anything like what they have been in the last year or two.

But cotton growers in other parts of the world must never forget that America can still dominate the cotton world if she likes, and that her powers of recovery are almost unlimited. If, for example, Texas were to tackle seriously the causes which have led to the deterioration of her crop, and if she had a year of reasonably good weather, she might in any season produce once more a supply of the good staple cotton on which formerly her reputation rested. But on that point the conclusion at present certainly is that there is no sign as yet of her doing so, and the longer it is delayed the greater will be the opportunity for other countries to fill the gap. After all "bread and butter" cotton is what the world most wants, and wherever a reasonable yield per acre can be assured it ought to pay the grower very well. America has lost her lead because not only the quality but also the yield per acre has fallen below the limit of profitable production.

SUGAR ABSTRACTS.

At the Third Congress of the International Society of Sugar Cane Technologists, held at Sourabaya, Java in June 1930, it was resolved that a new periodical be started which contained abstracts in the English language of all current technical literature on sugar cane. Arrangements have been made for the publication of these abstracts in a special section of the Journal *Facts about Sugar*. Since the Society is at present unable to pay abstractors, authors are urged to send their own abstracts for publication in the above named periodical. Abstracts should be informative only and will be edited in order to guarantee a uniform policy. The Editor of *Facts about Sugar* has offered to furnish reprints of the abstract papers at cost. Both abstracts and orders for subscription to the reprints should be addressed to him at 153, Waverley Place, New York. The general directions concerning the nature and style of the abstracts are given below.

Nature of Abstract.—The abstract should contain all important new information in sufficient detail to give a clear idea of what has been accomplished. The general reader should not find it necessary to refer to the original, and the specialist should be able to judge from the abstract whether or not he will have to do so. The abstracts of technical research work should not be in the form of summaries merely stating the subject treated and the results obtained, but should be analytical in nature, along the following general plan. They should include, in the order given, a statement of:

(1) The purpose of the investigation.
(2) The methods by which the worker has approached his subject and by which he has obtained a solution of his problem.
(3) The results actually obtained, and the conclusions drawn by the author of the article.

Such analytical abstracts are not necessary in the case of articles which merely represent discussions, restatements, or reviews of the literature, new books or monographs, criticisms of other articles, &c. In these cases descriptive abstracts will usually suffice.

Language.—All the abstracts are to be published in English.

Abbreviations.—No abbreviations should be used by the authors. The editor may introduce suitable abbreviations, a key to which is to be printed in the journal.

Manuscripts.—Whenever possible abstracts should be typewritten, double spaced, on one side of the paper only. If the author is unable to furnish typewritten copy, he should write as legibly as possible.

Heading of Abstract.—The headings should invariably be given in the following order:

(1) Title of article.
(2) Full names of author or authors.
(3) Name of journal.
(4) Serial number of the volume of the journal.
(5) Page number on which the article begins and page number on which it ends, with a dash between the two, thus 512-625.
(6) Year in which the article has been published, in parentheses, thus: (1930). An example follows:—

Polarization apparatus with photo-electric indication. W. E. Dickes. Z. Zuckerind. Czech. Rep. 51, 379-80 (1927).

Tables, Graphs and Drawings.—These should be used only when the information cannot be given in words in less space. In some cases graphs and drawings may actually save space; they should be sent in such form as to be reproducible without redrawing.

References.—References to previous literature should always be given, to assist the research worker. As soon as this journal has become established, reference should be made to abstracts previously appearing in it.

REPRINTS.

The following reprints of articles which have appeared in the Journal can be obtained on application to the Editor:—

Banana Fruit Diseases	C. W. Wardlaw	6*d.*
Bananas in Storage and Transport	C. W. Wardlaw and L. P. McGuire	6*d.*
Fruit and Vegetable Storage	L. P. McGuire	6*d.*
Panama Disease Research	C. W. Wardlaw	4*d.*
Soils and Flora	C. W. Wardlaw	6*d.*
Cacao Research	W. G. Freeman	6*d.*
Early Maturity in Cotton	S. C. Harland	2*d.*
Limes and Withertip	R. O. Williams	6*d.*
Trinidad Cotton Research Station	S. C. Harland	6*d.*
Rationalisation (Pts. I-V)	H. M. Leake	6*d.*
Labour Efficiency	E. A. Seagar	6*d.*
Defective Diet	E. A. Seagar	6*d.*
Parasitology in the Tropics	T. W. M. Cameron	4*d.*

THRIPS CONTROL.

Results of an attempt at controlling Thrips on a Cacao Estate situated in the Cunapo District, Ward of Turure, by spraying with Bordeaux mixture and its effect on crop production.

By Joseph de Verteuil, F.I.C., F.C.S.,
Agricultural Chemist, Department of Agriculture, Trinidad and Tobago.

AND

The Late Gaston de Verteuil,
Manager of the Estate.

The following trials and results are published in the hope of encouraging interested planters to make a further study of the question of thrip control on cacao plantations. Cacao thrips (*Selenothrips rubro-cinctus*), in the writer's opinion, are the worst enemy cacao planters have to contend with in districts where these insects are present in large numbers.

The writers are part owners of the property in question. For the past five years (1925-29), crop losses which they could attribute to no other cause than cacao thrips, turned their best paying property, to a non-paying proposition.

Thrips became first conspicuous in 1910; they increased in intensity during subsequent years, until, in 1925, the vitality of the cacao trees had become so weakened through frequent defoliation that their productivity was seriously diminished. During the whole of this period, the estate has been thoroughly worked, in-so-far as cutlassing, pruning, draining and round-ridging are concerned. Partial reduction of shade was attempted in certain fields, and, in 1927, the fields most seriously affected by thrips were forked, limed, re-drained and round-ridged without any beneficial effects.

The cacao crop records were kept from 1st July of one year to 30th June of the following year, and are as follows:—

Crop records.	*Bags of cacao of 165 lb. 1st July to 30th June.*
1907-10 (3 years average)	 380
1910-15 (5 do.)	 272
1915-20 (5 do.)	 236
1920-24 (4 do.)	 216
1924-29 (5 do.)	 135

The estate consists of two blocks, referred to as "A" and "B", within three-quarters of a mile of each other. The Cunapo River adjoins a section of both blocks.

In 1928, spraying with Bordeaux mixture was begun on Field III, then on Field I, and so on. The results are given below.

The results recorded above show that a larger increase of crop has been obtained from the sprayed fields than from the unsprayed fields, and that good results from spraying are indicated after one year's treatment.

In Block "A," there has been an increased yield of 124 and 166 lb. of commercial cacao per acre from Field III (sprayed) over and above the increase from Field IV the "control" field (not-sprayed) for 1928-29 and 1929-30 respectively as compared with the average yield for the four previous years.

Similarly, Field I (sprayed) has given an increased yield of 163 lb. of commercial cacao per acre over and above the increase from Field II the "control" field (not-sprayed) for 1929-30, on the average yield for the five previous years.

In Block "B," there has been an increased yield of 122 lb. of commercial cacao per acre from Field "Helene" (sprayed) over and above the increased yield from Field "Massy" (not-sprayed) for 1929-30 as compared with the average yield for the five previous years.

Field "Nicome" was sprayed too late to have any effect on the crop for the year ending 30th June, 1930.

Not only have thrips been controlled and practically eradicated on the sprayed fields (subject to infection from outside), but the crop of the estate has increased from 135 (five years average 1924-29) to 221 bags of cacao (crop for year ending 30th June, 1930), after one year's spraying of approximately one-half of the estate. Practically the whole of the increased crop has been obtained from the sprayed fields.

From a pecuniary point of view, no profit appears to have been derived from spraying, as the cost of spraying (two and three applications) per annum is greater than the value of the increased crop reaped. This, however, is not the only factor to be considered. In addition to a reduction in the percentage of black pods, the cacao trees, which were previously covered with moss, are now free from moss. This represents a value of from $5 to $6 per acre, which should be credited to the spraying. Moreover, the trees have been freed from moss in quicker time, in a more efficient and lasting manner, and with no damage to fruit or flowers which inevitably accompanies hand-mossing. On this estate the removal of moss by hand could not have been performed through scarcity of labour.

Three sprayings may appear to be extravagant, but it was undertaken deliberately to ensure thoroughness. The cost and effect of the last spraying may be carried over to the following crop. Moreover, the sprayed fields have a healthier appearance than the unsprayed fields. The cacao leaves are much larger, and the vitality of the trees has apparently increased. When all of these factors are taken into consideration, there can be little doubt that the cost of the spraying has been defrayed, even though after one year it shows no actual pecuniary gain.

Time for Spraying.

The following abstract is taken from Urich's* paper on the control of the cacao thrips. "As far as cacao is concerned, we can say that the thrips season begins with the rainy season, and that the

* *Bull. Dept. of Agric. Trinidad and Tobago*, Vol. XVIII, p. 86, 1919.

maximum multiplication takes place just after the heavy rains of May, June and July; roughly speaking, it may be stated that thrips begin with the setting of the cacao crop. All the time the leaves are young and not too tough and the rains are still on, thrips remain at the tops of the trees, but when the weather becomes drier they descend to the shaded pods and suckers, and can be found on these right through the dry season. A certain degree of moisture appears to be necessary for the well-being of thrips. At the height of the dry season, they are at their lowest ebb, but still never disappear entirely, and, if cacao does not offer suitable food, they will migrate to other host-plants that happen to be in tender foliage at that time."

Table of Results.

	Before Spraying.			After Spraying.			
Field Number.	Average yield (lb. cacao/acre).	Extremes of yield (lb. cacao/acre.)	Thrips Intensity.	Average yield (lb. cacao/acre).	Apparent increase due to Spraying.	Value of increased crop.	Average cost of each Spraying.
						$ c.	$ c.
Block A.							
I* ..	150 (5 yr. av.)	43-228	High	363 (1929-30)	163†	16.30	7.25
II ..	197 do.	109-301	Low	247 do.	—	—	—
III* ..	129 (4 yr. av.)	43-210	High	284 (1928-29)	124†	12.40	9.14
				379 (1929-30)	166	16.60	9.14
IV ..	195 do.	75-314	Low	226 (1928-29)	—	—	—
				279 (1929-30)	—	—	—
Block B.							
Helene* ..	220 (5 yr. av.)	108-275	Medium	376 (1929-30)	122†	12.20	9.50
Nicome* ..	246 do.	165-317	Medium	291 do.	11†	1.10	12.26
Massy ..	205 do.	151-293	Medium	239 do.	—	—	—

* Fields that were subsequently sprayed, the remaining fields serving as "controls."

† Results calculated thus:—*e.g.*, Field I.—Natural increase in yield for 1929-30 of *control field* (Field II) over the average yield for previous five years is 247 − 197 = 50 lb. cacao/acre. Increase in yield of *sprayed field* (Field I) for same period is 363 − 150 = 213 lb. Hence, increase apparently due to spraying is 213 − 50 = 163 lb. cacao/acre, which is the figure given. The same method of calculation is used for other pairs of fields, *i.e.*, III and IV; Helene and Massy; Nicome and Massy.

Notes.

Field I.—Forked, limed (two tons/acre) and redrained in 1927.
Half of shade removed in 1930.
Sprayed *three times*, *i.e.*, November, 1928 to January, 1929; February to March, 1929; July to August, 1929.
Quantity of Bordeaux mixture used at each spraying, 440 gallons per acre.

Fields II, IV.—Drained and round-ridged; no shade removed.
Not sprayed; fields served as "controls."

Field III.—Half of shade removed in 1922. Forked, limed (one ton/acre), drained and round-ridged in 1927.
Sprayed *four times*, *i.e.*, January to March, 1928; September to October, 1928; March to May, 1929; August to September, 1929.
Quantity of Bordeaux mixture used at each spraying, 509 gallons per acre.

Helene.—Half of shade removed in 1923. Forked, limed (one ton/acre), drained and round-ridged in 1928.
Sprayed *twice*, *i.e.*, May to July, 1929; October to November, 1929.
Quantity of Bordeaux mixture used at each spraying, 577 gallons per acre.

Nicome.—Sprayed *once* only, *i.e.*, December, 1929 to March, 1930.
Quantity of Bordeaux mixture used, 745 gallons per acre.

Massy.—*Not sprayed*; field served as "control" for the other two fields of Block "B."

In the writers' opinion, the time for spraying is immaterial with one exception and that is when the trees are in *young* leaf, as it is practically impossible to spray the under-side of the leaves and the spray does not adhere. No spraying should be done when rain is actually falling. In other words "Spray when able." When thrips are present, the spray will destroy them; when they are absent, the coating of Bordeaux mixture on the under-side of the leaves and pods will repel them. An attempt should be made, however, to do as much spraying as possible between September and January when a fair crop of fruit is on the trees, as it also assists in preventing black rot of pods (*Phytophthora*).

Summary.

The property in question is situated in the Cunapo District, Ward of Tururе.

Up to 1910, it was one of the best yielding properties in the district, giving an average yield of 12 bags (165 lb.) of commercial cacao per 1,000 pickets, or about 3⅓ bags per acre. From the end of 1910, thrips became prevalent, and gradually increased in intensity, and so reduced the crop, that the average of the five years 1924-29 had reached the low level of 4¼ bags per 1,000 pickets, or about 1¼ bags per acre.

The property has always been well worked, and no special cultural operations, including liming, has had any effect in controlling thrips or in maintaining the yield of the estate.

Spraying with Bordeaux mixture was begun in 1928, and, with the exception of Field III, could have had no effect on the crop before the year ending June, 1930. Not only have thrips been controlled and practically eradicated on the sprayed fields (subject to infection from outside), but the crop from the sprayed fields has increased nearly one bag per acre over and above the increase from the unsprayed fields.

The crop from the whole estate, after spraying only one-half of the area, has been increased from 4¼ to 7 bags per 1,000 pickets, *i.e.*, from 1¼ to 2 bags per acre. The value of the increased crop, however, at present prices of cacao, is not sufficient to pay for the cost of spraying, but, if the cost of freeing the trees from moss is included, the cost of spraying has been adequately defrayed.

SUPPLEMENTS.

The following Supplements to the Journal can be obtained on application to the Editor:

1927 Sugar Supplement	..	1*s.*
Sugar Cost Accounts	..G. C. Skinner	1*s.*
Wilt Diseases of Coconut Palms.—(Parts I and II)	H. R. Briton-Jones	6*d.* each.
Giant Moth Borer of Sugar-Cane..	..H. Martyn Skinner	6*d.*

NODULE ORGANISMS.

The Relation of the Nodule Organism (*Bact radicicola*") to its Host Plant.

THE factors which control the infection of the host plant roots by the nodule organism fall into two classes. There are firstly those that ensure the presence of a sufficient number of the organisms at the seat of infection, the root hairs, and secondly, those that enable the organisms present to infect the hairs and to produce the nodules. The presence of the bacteria amongst the root hairs by no means ensures infection, for when the roots of a legume are immersed in a thick suspension of the appropriate organism, only about four per cent. of the root hairs are invaded. Young seedlings of lucerne do not, as a rule, show nodules until the stage is reached at which the first true leaves open. There is evidence, that, at this stage, a substance is secreted from the roots which assists the entry of the bacteria. Infection of the root hairs is always accompanied by a characteristic curling or deformation of the tip of the hair, which is caused by a filterable secretion of the bacteria. There is some evidence that the root hairs on seedlings are not curled until after the opening of the first true leaves, suggesting that the root secretion also plays a part in producing the curling. The composition of the cell wall in the deformed region appears to be modified and it is perhaps due to this that the organisms can enter at this spot.

The bacteria penetrate the tissues of the root cortex in the form of a thread of bacterial zoogloea from which irregular masses of zoogloea grow out within the cells. The thread itself becomes encased in a sheath which is chemically similar to the walls of the host cortical cells and is probably a secretion of the plant. Release of bacteria from the ensheathed infection thread into the host cytoplasm takes place by the formation of blister-like swellings of the sheath which eventually burst.

The relation between the host plant and the bacteria within the nodule cells is normally one of symbiosis, the former receiving nitrogen compounds fixed by the bacteria, which in turn are supplied with carbohydrate energy material by the plant. This relationship can be converted into one of true parasitism by withholding the supply of carbohydrate to the nodule. This has been done by growing the host plant in darkness, thus stopping photosynthesis, and by growing it in a solution deficient in boron, which results in the vascular supply to the nodules being absent or deficient. Under these conditions the bacteria attack and destroy first the cytoplasm and nuclei of the cells in which they lie and, finally, the cell walls. The destruction of old nodules at the end of the season is brought about by a similar destruction of the nodule tissue by the bacteria.—(*Fifth International Botanical Congress, Cambridge. Abstracts of Communications.*)

FIBRE PRODUCTION.

Hybrid Vigour and Fibre Production.

MAN may not consume more vegetable food *per capita* now than in days past, but it is certain that the amount of vegetable fibre employed to clothe him, and to spread before his eyes the printed word, increases from year to year, and the subject of vegetable sources for our cellulose supplies is frequently canvassed as a result.

In a very interesting and suggestive chapter in their text-book "Genetics in Relation to Agriculture," Messrs. Babcock and Claussen, two distinguished geneticists of the University of California at Berkeley, point out that rapid vegetable growth, in all kinds of plants is frequently very marked in the first generation hybrid offspring of crosses between species or varieties; it is impossible to define the procedure too accurately in view of the confusion that surrounds the taxonomists' definition of a species, but these authors were referring to a familiar phenomenon which very early received attention in the history of breeding experiments.

The rapid production of cellulose for the voracious maw of the printing press depends upon the rapid growth of the plant, and in America, following the lead of such geneticists as Babcock and Claussen, the foresters are exploring the possibilities of hybridisation as the source of an F_1 generation of trees which shall grow more quickly than either parent. The intention, of course, is to propagate such a vigorous seedling when procured by vegetative means. In such a 'clone' of vegetatively propagated trees the hybrid vigour of the original plant may be expected to persist, and when, as in the case of the paper pulp industry, the essential point is quantitative yield of wood, to a certain extent regardless of quality, the problem is relatively clear-cut and there seems considerable possibility of attainment of the practical end in view.

Where, however, plants of briefer duration of life are concerned, and where each new generation of plants is raised from seed, at first sight the possibility of obtaining more vigorously growing plants as the result of hybridisation seems very remote. As is well known, in subsequent generations, the Mendelian growth factors, combined in the F_1 hybrid, usually segregate independently and there is little likelihood of many seedlings of the new F_2 generation containing that happy summation of dominant factors contributing to vigorous growth which were fortunately combined by the cross making the F_1 plant. However, in recent years numerous cases have come to light where many factors, thus first brought together in a cross, have remained together during subsequent generations as the result of that obscure process controlling the fusion and sorting of the constituents of the chromosome which are grouped under the term 'linkage.' It is, therefore, perhaps worth pointing out that at the present time two plants which are or have been under trial as sources of fibre may represent the offspring of a natural hybrid.

Professor F. W. Oliver, now enjoying his well-earned rest from the Department of Botany, University College, Gower Street, by taking charge for a short period of the Botanical Department of the University of Cairo, has frequently directed attention to the vigorous growth of one of these plants—rice grass or cord grass, *Spartina Townsendii*.

Three articles upon this grass, upon its distribution, its use in reclaiming maritime muds and resisting foreshore erosion, and as a fodder, &c., appeared in the *Journal of the Ministry of Agriculture* recently, and were reprinted by the Ministry as Miscellaneous Publication No. 66; whilst, during the War, experiments were made with this plant in paper-making. As Professor Oliver points out in his contribution in these articles, we are still uncertain of the accuracy of the assumption that this grass arose as a hybrid between the species *S. alterniflora* and *S. stricta*, experiments made in crossing the putative parents having so far been without result. If a hybrid, it is at least remarkable that no segregates have been discovered during the fifty years in which the spread of *S. Townsendii* has now been observed.

In the other case, the plant in question is under much more vigorous exploitation as a fibre plant, 'Brotex.' Its botanical history is far less known than that of *Spartina Townsendii*, as its examination has been conducted for commercial rather than scientific ends. We are told, however, that this malvaceous plant is a hybrid biennial which comes true to seed and can be grown successfully in Devonshire, with vigorous production of fibre. There seems little doubt that a valuable fibre can be obtained from the plant; it has still, of course, to establish its place as a commercial source of fibre.

Again, we seem to be confronted with a case of vigorous cell wall production by a plant of hybrid origin. If the claims for the plant are justified and this vigour of growth maintained in subsequent years as in the case of *Spartina*, once more the question arises whether linkage has established amongst the hybrid offspring a stable and vigorous race of plants.

The whole subject of the utilisation of hybrid vigour, for fibre production as for fruit and vegetable production in the service of man, is a fascinating topic fraught with great practical possibilities. In view, especially, of the utilisation of Britain's tropical resources, it is to be hoped that its investigation will not be left to America; but, on a conservative estimate, twenty times the number of scientific workers are engaged in the study of plant genetics in the United States compared with the number of workers in this field in the British Empire.—(*Nature*, Vol. CXXV, No. 3147.)

TROPICAL WORLD NOTES.

Uganda.

According to the *Colonial Report* for 1929 (No. 1486) the total value of the domestic exports of Uganda during 1929 in terms of *f.o.b.* value Mombasa was £4,274,758, as compared with £3,395,270 in 1928, an increase of £879,488 or 26 per cent., the most important item in the list of exports being cotton which with cotton-seed, represented 87 per cent. of the total domestic exports of the Protectorate. 1929 was a prosperous year, the cotton crop being the largest ever recorded. Owing, however, to plant diseases, unreasonable weather and a sharp fall in prices, it is predicted that the 1930 year will be a very lean one indeed. The difficulties which confronted the cotton industry on account of the excessive number of ginneries in the country and the unpopularity among the native growers of the steps taken by the ginners to reduce, by means of combines, the consequent cut-throat competition led to the appointment of a Commission of Inquiry early in the year 1929. This resulted in the collection of much useful information regarding the industry, its cost and organization, and in recommendations the most important of which were concerned with the reorganisation of the ginning side of the industry by means of co-operative associations.

With regard to coffee an increasing interest has been shown in the cultivation of *C. robusta* by non-natives, particularly in the more humid areas of the Buganda Province, whilst the area under *C. arabica* cultivated by non-natives shows a steady increase in the Toro District. The coffee crop in 1929 was above the average, and good yields were obtained in most districts. This position was, however, largely discounted by the fall in prices towards the end of the year, when the bulk of the crop was being marketed. The native coffee industry showed a steady expansion, and the free distribution of *C. robusta* plants continued throughout the year in the Buganda Province. The exports of coffee from the Protectorate during the year amounted to 41,192 cwt., valued at £177,142 as compared with 40,355 cwt., valued at £164,187 in 1928.

Experimental work in connection with the tobacco crop has been continued in the Bunyoro District, and the comparatively small crop produced in that area by native growers was purchased by the British American Tobacco Company for use in their factory at Jinja. It is realized that only good types of well-prepared leaf can be expected to find a ready export market, and for this reason the development of tobacco-growing by natives is being proceeded with cautiously. Non-natives continue to show an interest in this crop. Exports during the year amounted to 61,967 lb., valued at £3,040.

Large quantities of improved varieties of maize seed were distributed by the Department of Agriculture during the year and there has been a considerable increase in the acreage planted, particularly in the vicinity of the larger towns. Mills for the production of maize flour have been erected in several centres in the Buganda and Eastern Provinces, and it is hoped that in the near future Uganda will at least be able to supply its own requirements in this direction.

A scheme was put into operation in the Eastern Province whereby numerous blocks of 100 acres each were cleared and stumped with the object of demonstrating to those natives who have not already realized it, the advantage to be gained by the use of ploughs and the proper rotation of crops.

* * *

Sierra Leone.

In view of the great depression in the oil-nut industry in 1929, it is not surprising that the Annual Report of Mr. R. B. Mackie, Comptroller of Customs, Sierra Leone, reveals a position that, unsatisfactory in itself, holds little hope of great improvement in the current year.

The exports amounted to £1,532,237, or a decrease of £296,856. Palm-kernels fell by 6,900 tons, value £274,341, to 60,205 tons and £876,308, the water-borne kernels trade suffering least, since it was possible to pass on part of the saving in freight to the producers. The quality of such kernels, however, was on the whole less good than the others—a fact which shows that produce inspection may sometimes be opposed by more material foes than the "conservatism" or "laziness" of farmers, for in 1929 it was the purveyors of the poorer kernels that obtained the better price. There was a small increase of 320 tons and £8,708 in palm-oil to 2,845 tons and £75,153, but the total was nevertheless below the average of recent years. Kola exports amounted to 7,005,078 lb., value £266,422, or a decrease of 385,482 lb. and £15,575, which was well up to the recent average. Sierra Leone was losing in Senegal to Grand Bassam, owing to the preferential tariff, while the decreased purchasing power of the Gambia led to another reduction, which, however, might more correctly be ascribed to the same preferential tariff on re-exports to the interior. Northern Nigeria was the chief market, and it is interesting to note that while the opening of the Nigerian kola trade was due to Syrians, it was likewise Syrians who had caused the competition in Grand Bassam nuts. Ginger showed an increase of 10,535 cwt., value £28,726, to 30,966 cwt. and £59,308, thanks to an improved world market, but producers were content to despatch a second-grade product, holding that further care in preparation was not worth while. Piassava fell by 1,957 tons and £23,192 to 1,232 tons and £17,177, and pepper by £5,423 to £5,131. Cocoa showed an increase of 12 tons and £222 to 96 tons and £3,398, but shipments were considered disappointing, and the price realised was £10 a ton below Accra. The remaining exports were benniseed, £2,997, rice, £220 and hides, £2,768. Of the last-named, the untanned cattle-hides went to Marseilles, and the tanned ones to the Gold Coast, while the skins of sheep and goats were insufficient to supply the demands of the Sierra Leone leather-workers themselves.

Nyasaland.

According to the Colonial Report for 1929 (No. 1489) the exports and local values of the five principal crops during the past three years have been as follows :—

	1927.		1928.		1929.	
	Tons.	£	Tons.	£	Tons.	£
Tobacco	6,905	780,964	5,193	496,561	5,400	478,060
Cotton	826	45,834	797	58,264	947	62,660
Sisal ..	801	24,428	1,162	29,814	1,200	34,464
Tea ..	522	56,640	637	73,599	784	74,382
Coffee ..	16	1,203	21	1,542	44	3,239

Tobacco.—The European acreage was approximately 3,000 less than in 1928, and climatic conditions were not favourable over the greater part of the Shire Highlands, in consequence of which both yield and quality were below normal, the total crop being 2,289 tons, as against 4,068 tons in 1928. The bulk of the native tobacco crop is produced in the Central Province, where climatic conditions are decidedly different, and the abnormal character of the January-April rains was as beneficial in this area as they proved injurious in the Shire Highlands. The total native grown crop was 3,881 tons as against 2,414 tons in 1928. There was an increase in the number of native growers from 34,761 in the previous season to 47,578 and the increase occurred in all provinces. The quality and the yield was, however, far superior in the Central Province. In this area in which the Native Tobacco Board's efforts are concentrated, an innovation which proved most successful was the concentration of licensed buyers at eight buying stations, and the inspection by officers of the Board of all tobacco offered for sale.

Cotton :—Although the European acreage return for 1929 showed a slight increase on that of 1928, there was a reduction in lint, from 52 tons in 1928 to 37 tons in 1929. There was however, a very marked increase in the native production, good as it was in 1928, the figures in terms of seed cotton being 3,505 tons in 1929 as against 2,486 tons in the previous year. The increase is due largely to excellent climatic conditions on the Lower River, where the bulk of the native crop is produced, though credit must be given to the propaganda work of the District Commissioners, the agricultural staff, and the British Cotton Growing Association.

Sisal :—There is a slightly increased acreage, and the actual production increased from 1,179 tons in 1928 to 1,230 tons in 1929.

Tea :—There is a steady increase in the area, the 1929 acreage being 8,866 as against 7,596 in the previous year, whilst the yield was raised from 628 tons to 778 tons. The reduced prices obtained seem to have encouraged more and more attention being given to the various phases of cultivation and manufacture, in order to effect the most economical production.

Coffee :—There was a slight increase in acreage, from 1,281 to 1,331 whilst the production was raised from 33 tons to 57 tons.

* * *

Mauritius.

Preliminary estimates of the Mauritius Department of Agriculture place the probable yield of the 1930-31 sugar crop at 213,580 long tons, which compares with 234,207 produced in 1929-30. The estimate is considered somewhat conservative in commercial circles, where it is believed that the final yield will be about 221,000 tons.—(*Facts About Sugar*, Vol. XXV, No. 27.)

* * *

Virgin Islands.

The Reports of the Virgin Islands (U.S.A.) Agricultural Experiment Station at St. Croix for 1928 and 1929 have recently been received. These reports give an interesting account of the work of this Station, briefly stated.

The hurricane of September, 1928, seriously affected the agriculture of the Island. The sugar crop in 1927-1928 was approximately 12,000 short tons, that of the following year was reduced to 4,000 short tons. This reduction was largely due to the prolonged and intense drought in 1928, and, to some extent, to the hurricane which followed. Experiments with truck crops including tomatoes, eggplants, peppers and Bermuda onions were carried out with the view to marketing in New York during the winter. The Bonnie Best tomato was grown, the hurricane damaged the seedlings in the seed bed, and because there were no re-plants available only some 75 to 80 per cent. of a stand was developed in the field. The cost including all charges on shipments totalling 332 crates between 1st December and 15th March was $2.73 per crate which was $1.50 more than the average selling price. The Black Beauty eggplant produced 95 crates which were shipped between 21st December and 15th February, which sold in New York from 50c. to $5.00 per crate with an average of $2.27. Again the total cost for production and marketing was more than the average selling price. Six shipments of Ruby King pepper, totalling 13 crates, which sold in New York at prices from $2.00 to $6.00 per crate produced a small profit. A trial is being made in St. Croix in the production of tomato seed for planting, the Marglobe variety being used for this purpose. It is found that one ton of Marglobe tomatoes yielded 12,325 lb. of seed. In the forage crop work, the cowpea, and the pigeon pea and velvet bean have been found to have considerable value as stock feed. The common blue wis or butterfly pea (*Clitoria ternatea*) and the small blue wis (*Teramnus labialis*) are recommended to be encouraged in every pasture. Uba cane, Elephant grass, Guatemala grass, and the grain sorghums were all found to be good sources of stock food. The recorded rainfall at the Experiment Station, St. Croix, for the year ended 30th June, 1928, was 47 inches, and for the year ended 30th June, 1929, 38 inches.

SUGAR NOTES.

Compiled by the College Department of Sugar Technology.

Effect of Humidity on the Deterioration of Raw Sugar on Storage.

During the present period of excessive production, the problem of storing sugar with a minimum loss of sugar becomes an important one. An investigation has been undertaken using Philippine raws and refined in order more particularly to determine the sucrose loss under various conditions, especially relative humidity. Sugars were kept in humidity chambers at a constant temperature of 27.5°C. during varying periods of time, at the end of which they were analysed. On the average all sugars showed no deterioration at a relative humidity of around 68 per cent. Below this point they gained in sucrose due to the removal of water; but above it sucrose was destroyed, especially above 84, when the deterioration was exceedingly rapid. This considerable deterioration does not occur throughout the entire contents of the sack, being (as one would expect) least in the interior. Observations were made of the number of micro-organisms per c.c. under the different conditions. In general there occurred no increase in organisms up to 70 per cent. humidity during any length of exposure; but above 75 all sugars develop deteriorating organisms at practically the same rate if sufficient time be allowed. Their development appears to follow a geometrical relationship. Another point investigated was the effect of humidity on the caking, known to be due to the presence of a gum of indefinite composition, dry at a low moisture content, and extremely sticky when more water is present. When yet more water is present, the gum becomes colloidal, and loses its adhesive or sticky property. Caking of all sugars took place below 70 per cent. relative humidity; at 75 per cent. it was particularly apparent; but at a greater humidity, viz.: 80 per cent. no difference was noted between samples, all being moist and loose. Sanitary conditions of centrifugals, especially clean floors and wash-water, and general mill and boiling-house sanitation will reduce contamination, but maintenance of humidity inimical to micro-organisms will prevent loss. The deterioration factor at the time of sacking (moisture divided by 100-pol.) is not a measure of the possible deterioration under tropical and sea-side storage conditions. Equally worthless is the "count" of micro-organisms. Essential features of the construction of a sugar warehouse to keep raw sugar for a considerable period without deterioration are: Elimination of draughts; adequate soil drainage; impermeable floor; economic piling and unloading; and maintenance of constant humidity. Details of constructions of such a building were given in the Committee Reports of the Philippine Sugar Association for 1924, and are exceedingly exact. Storage houses built under this plant keep raw sugars for a considerable period without deterioration.—(*International Sugar Journal*, Vol. XXXII, No. 382.)

* * *

Filtration Investigations in Natal.

(*Using Filter-Presses, Double Pressing and Rotary Filters.*)

Sugar lost in filter-cakes of Natal factories, two per cent. on the sugar entering the factory, is an indication of the very refractory nature of the product handled. Higher dilution of the settlings does not appear economical as few Natal factories appear to have a superfluity of steam, subsiding tank or filter capacity. Washing the cake in the press in the usual way gives indifferent results and at times is impracticable. By introducing the wash-water through the feed line to the press without interrupting the continuity of flow, better results have been recorded, but the resultant cake is usually wet and sloppy, an undesirable feature as regards transport facilities. This further means a multiplicity of pumps. Double filtration has been given an extended trial. The reduction of the sucrose content of the cake appears quite satisfactory though the recovery of sucrose has been accompanied by the extraction of a considerable amount of impurities as is evidenced by the depression of the purity quotient of the second filtrate. This led to the abandonment of the process for the time being.

Dilution and decantation of the settlings had, therefore, to be accepted as the standard procedure, the separation of the juices as in the Petree process being retained, the muds from the rich or primary juice diluted by a mixture with the secondary juice prior to clarification, and the resultant settlings again diluted and decanted before pressing. This practice is favoured by some Australian factories, with the exception that the filter pressing is omitted, the final settling being considered sufficiently exhausted and thickened to run to waste—a very happy circumstance indeed. This practice appears to be a rather uneconomical way of using water, and consequently steam for heating and evaporation. Filtration to obtain a cake of sucrose content 2.5 per cent.; moisture 56 per cent.; purity of contained juice 80; and Brix, therefore 5.3. Assume the settlings 20 per cent. weight of cane containing juice 18.8 per cent. of 15 Brix; water required to dilute juice to 5.3 Brix; = 183 per cent. on juice settlings, or 34.4 per cent. on cane. Assuming 1 lb. bagasse will give 2.5 lb. steam; 1 lb. steam in quad to evaporate 4 lb. water, and bagasse per cent. cane 30. The fuel required to remove the dilution water in evaporator alone amounts to 11.5 per cent. of the total supply. This, though a somewhat exaggerated example, would tend to explain to some extent our present high filter-loss.

Eventually, a continuous rotary vacuum filter of the Mause patented type was installed, and operated over a portion of last season. Testing its possibilities as a second filter to the plate-and-frame machines, the cakes were broken down to a fairly homogeneous sludge to a solid content of 15 to 19 per cent. The estimated loss of sucrose in filter-cake in this method of double filtration terms of sucrose in cane is estimated at 39 per cent. or a reduction of over one per cent. on the usual figure. The capacity of the filter on this work is quoted as 12 lb. press-cake per square foot per hour, or assuming press cake to be 3.5 per cent. on cane, 5.38 square feet filtering area per ton cane. This compares very favourably with the filter-press figure, in double filtration. As a direct filter, the machine gave quite satisfactory results though the thickness of cake is greatly decreased, being $\frac{1}{8}$ to $\frac{1}{4}$ inch thick. Over an observed run, the filter handled settlings at the rate per square foot per hour of, minimum, 18.12 lb. maximum 39.2, average 23.6. This latter figure indicates a filtering area of 17 square feet per ton of cane. Wash-water to the extent of five per cent. on weight of cane proved sufficient to reduce the sucrose content of cake to 2.5 per cent. with a purity of filtered juice comparable to that from the presses. Moisture of cake is somewhat higher than that of filter-press cakes, contents of 70 per cent. and over being recorded. The cake, however, is quite firm even at these high moisture contents and affords no greater difficulties in regard to transportation and disposal than does filter-press cake. An endeavour was made to estimate the probable recovery of sugar and labour and cloth charges in comparison with the filter-press and is shown in the following tabulation of results, necessarily rather approximate :—

	Filter Press. Present Pract. 1929-30 Season.	*Filter Press. Double Filt. Recorded run.*	*(Estimated) Vacuum Filter. Double Filt.*	*Direct Filt.*
Sucrose per cent. cake	5.95	1.48	1.63	2.50
Sucrose lost in cake per cent. ..	1.47	0.35	0.39	0.75
Recoverable sucrose per cent. ..	—	—	—	—
Sucrose in cane (S.M.J. Sug.98 Mol. 45) ..	—	0.59	0.78	0.59
Relative operating cost (Labour and and Cloth)	1.00	1.25	1.18	0.23

(In the discussion following this paper, it was pointed out that the average loss of 2 per cent. in Natal compared with only $\frac{1}{2}$ per cent. in Java ; that many mill owners will spend thousands of pounds on one mill to return $1\frac{1}{2}$ per cent. higher extraction ; and that it would seem as though the day of the filter-press would come to an end before long.) — (*International Sugar Journal*, Vol. XXXII, No. 381.)

FRUIT NOTES.

Patch Budding of Mangoes.

THERE are throughout the West Indian Islands many vigorous mango trees of the common varieties, which produce fruits of no value for shipping in connection with the Fruit Trade, and in fact, many of them are in no demand for local consumption. The Department of Agriculture in Jamaica has published a circular on the budding of mangoes in which the method known as patch budding is described. In Jamaica the mango known as the "Bombay" is well established, and this has been proved to be suitable for the English market. Other varieties which are suitable for an export trade may be capable of being propagated by patch budding. The following is extracted from the circular of the Department of Science and Agriculture, Jamaica, already referred to :—

Preparation of Stock.

"If seedlings are planted out they will be ready for budding when they have reached a size of from one inch to two inches in diameter.

In the case of old trees, all the branches, except one, should be cut back. The cut surface should be tarred to prevent the attack of fungi. In a short time several 'shoots' will appear. These should be trimmed leaving about two or three to develop until they are about 18 months old or when they have reached the size of from one inch to two inches in diameter. The remaining branch which was left to keep the tree alive should now be pruned off and the cut surface tarred.

Time for Budding.

The best time for budding depends on several conditions, such as the weather and the receptive condition of the stock. The operation can be successfully performed only when the bark separates readily from the stock without leaving any fibres and presenting a smooth shining surface. Both the stock and bud are usually found to lift quite easily between the months of March and June.

Method of Budding.

Patch budding consists in taking out an inverted triangular piece bearing a bud from the scion, which should be about two years old or at least one inch in diameter and transferring it to a similar shaped opening cut in the bark of the stock. The base of the triangle should be at least one and a half inches with sides not less than two inches. To ensure success it is very necessary that both the stock and the scion from which the bud is taken should be in a proper condition for the easy lifting of the bark. It is very important that the opening in the stock should be made accurately and smoothly, and that a well-fitted bud should be transferred expeditiously. If the operation is not done quickly the exposed cambium cells in both the

stock and scion will be more or less dried, thereby minimising the chances of a union taking place. It is, however, not necessary that the bud should fit absolutely closely, as in the case of the mango the union of cambium layers takes place under the bark and very seldom along the cut edges, hence the importance of having some active cambium both on the stock and bud.

Care of the Bud.

Immediately after the bud has been inserted it should be firmly bandaged with raffia or other suitable material so as to hold the bud in close contact with the stock. Great care should be exercised to leave the eye of the bud exposed. The bud should be protected from the direct rays of the sun either by inserting it due north or south, where possible, or by allowing a leaf or a strip of tape to hang over. This provision will also protect the bud from rain which is just as injurious to the bud as the direct rays of the sun.

A ring should be cut around the stock immediately above the bud to arrest the flow of sap and hasten the growth of the bud.

In the course of three weeks the buds should be examined when their plumpness and greenness will serve to indicate that union between the bud and stock has taken place. Buds in this condition may be partially unwrapped; other buds should be left securely wrapped for a week or ten days longer. All buds that are still green after 21 days are certain to grow. As soon as the bud has taken, the stock should be cut off a few inches above the bud to hasten its growth. When the bud begins to grow the stock should be further cut in a slanting position within an inch or two of the bud and the cut surface tarred.

Best Varieties for budding.

Although budding may be done successfully on any of the inferior varieties, the most successful results will be found in budding on such stock as Beef Mango, No. 11, and Hairy Black and Common."

* * *

Pine Apples in Puerto Rico.

For several years past the Puerto Rico Agricultural Experiment Station at Mayaguez has issued Agricultural Notes. These have been circulated in memiograph form since May, 1925. Twenty-four of these articles have dealt with pineapples problems, the latest of these is dated May, 1930. These notes always contain interesting information and this latest issue which deals with slips and suckers is no exception to the general rule. It is stated that the problem of slips and suckers has not been entirely solved, but the amount of data that has been accumulated is considered to justify the publication of the article. The pineapple is propagated mainly by means of slips and suckers. In Puerto Rico crown slips are not planted because they are too small. Crowns from large fruit have given satisfactory results. It has been shown that some improvement in the quality of the plant can be obtained by selecting in the field before the fruit is picked, the best plants, and marking them with a daub of paint on a leaf. For this purpose a large stalky plant bearing a large fruit, an abundance of slips and suckers is selected. A certain amount of the planting material will be rejected, some growers reject all slips less than five inches long, and others plant none less than eight inches long. Suckers more than ten inches long are usually rejected. A slip or sucker should be stout with broad firm leaves.

Several million plants were imported into Puerto Rico from Cuba in 1921 to 1923, these proved to be generally superior to the majority of the plants then grown in Puerto Rico, and the progeny has continued to produce desirable plants and fruit under favourable soil and cultural conditions. This naturally suggested the possibility that the strain or strains of Red Spanish grown in Cuba might be superior to those grown in Puerto Rico. It has been found that the characteristics of the Cuban plant may be reproduced from generation to generation under soil and cultural conditions favourable to the pineapple plant. It is unquestionable, however, that unfavourable environments may cause damage to one generation of plants which may not be overcome in several succeeding generations under favourable environments. The conditions of soil, fertiliser, moisture, planting and cultivation, all have an influence on the habit of growth of the plant, and on the colour, and often, the shape of the fruit. Plants in a two row bed or in the outside rows of a four row bed are better developed and produce larger fruit than those in the two middle rows of a four row bed, especially when the soil is not entirely suitable.

In connection with the attempts that are being made to develop a fruit trade in the Windward and Leeward Islands, there has been a considerable demand for planting material of pineapples during the past two years. Both the slips and suckers of the pineapple have been difficult to obtain. The Agricultural Superintendent, St. Lucia, is employing a method of rapid propagation which appears to be successful. The test of the method will come, however, when it has been seen what development these plants make, how prolific they are in bearing, and to what extent they reproduce the desirable characteristics of the parent plants. Briefly, the method is as follows:—The rhizome, prior to the fruiting of the plant, is cut across into slices about one quarter to half an inch thick. These disks are dipped in potassium permanganate (five per cent. solution) and planted in good mould covered with a layer of sand. They are watered with a weak solution of sulphate of ammonia. Usually three buds grow, the first appearing some time before the other two. By removing the first plantlet when about one inch high or less with one-third of the disk attached, the remaining two buds develop quickly. The plants make rapid growth. It is not yet known how long it will take before such plants produce fruit, but this will be recorded in due course.

H.A.B.

FIG. 5.— *An excellent exportable bunch.* (*Palma.*)

FIG. 6.— *An irregular "May" bunch.* (*Teneriffe.*)

THE CANARY BANANA.

FIG. 7.—*A satisfactory method of carrying Cavendish bunches.* (*Palma.*)

FIG. 8.—*Method of handling Cavendish bunches between plantation and packing shed.* (*Palma.*)

FIG. 9.—*Loading crates of bananas at Santa Cruz.* (*Teneriffe.*)

MYCOLOGICAL NOTES.

Sugar-Cane Diseases in Mauritius, by G. Orian.

Brief notes are given on the occurrence and severity in 1929 of the principal sugar-cane diseases in Mauritius. Pineapple disease (*Ceratostomella paradoxa*) appears to have been locally more severe than in 1928; some plantings were almost completely destroyed by this disease, a result in part attributed to the poor quality of setts used by many planters. Morve rouge red rot, (*Colletotrichum falcatum*), is not generally of great economic importance, since the chief sugar-cane varieties in use in Mauritius, with the exception of D.K.74 and M.131, are fairly resistant to it, a certain degree of susceptibility was also observed, however, in the R.P.6 variety. Gummosis (*Bacterium vascularum*) and leaf scald (*Bact. Albilineans*) are fairly common; the varieties D.109, M.131, and M.55 are very susceptible to leaf infection, while the white Big Tanna, which is very resistant to this form, is very liable to stem infection, and D.K.74 is resistant to both. Smut (*Ustilago scitaminea*) was much less prevalent than in 1928; along the littoral it chiefly affects the varieties D.K.74, M.131, and R.P.8 from November to March or April. The white Big Tanna variety suffers from an undetermined root rot in wet clay soils; M.55 suffered in 1928 from a similar disease in a field, in which certain pure lines of M.131 remained immune and grew well. In the north of the island D.130 continues to be affected with a root rot, which cannot apparently be ascribed to soil conditions.

With reference to the description given by him in a previous paper of the various stages of "pokkah-boeng" in Mauritius, the author points out that the condition of the cane tops tentatively described as a stage of the trouble has been since recognised in Cuba by Priode as distinct from pokkah-boeng and named "twisted top"; it is also believed to be identical with the disease known as "tangle top" or "top knot" in Queensland. Cases of true pokkah-boeng (partial rot of the leaves, occasionally followed by rot of the pith and of the stems) were frequently observed in Mauritius from January to June, 1928, but were considerably less frequent and occurred much later in the season in 1929, probably owing to the dry weather at the beginning of the year. The varieties M.522, 94/26, and L.B. 111/14 appear to be susceptible to the disease in the Departmental nurseries, but exhibit a high degree of tolerance to it. A description is given of a peculiar form of inflorescence rot, which, it is believed, may be related to pokkah-boeng. The more or less developed inflorescences rot while still enclosed in the top, the infection then spreads to all the young nodes, to which it remains localized, and numerous adventitious buds are formed on the topmost nodes of the canes. When infection is slight and occurs at the time of formation of the inflorescence, the latter appears to revert to vegetative life, and produces a large number of atrophied, narrow leaves which emerge in a bunch at the top. This condition has been described by Lyon from Hawaii under the name of "bunch-top." Cases of this inflorescence rot were very rare in Mauritius in 1928, and only occurred on the white Big Tanna variety; in 1929, however, they were very prevalent, especially on the white Big Tanna, D.K.74, M.131, D.109, and some as yet unreleased nursery varieties. This disease causes very little, if any, damage to the sugar-cane.

Streak disease in Mauritius only occurs on the R.P.8 variety, which is an importation from Demerara, and is not apparently spreading in the island. The eye-spot disease (*Helminthosporium ocellum*) is stated to be the most serious leaf disease, especially on the 53/26 and D.109 varieties. The disease has never been observed so far, to cause a pith rot of the canes. (*Rev. of Applied Mycology*, Vol. IX, Part 5.)

* * *

The Relative Resistance of Varieties and Species of Citrus to Bark Diseases, by L. J. Klotz and H. S. Fawcett.

In a series of inoculation experiments with *Phytophthora citrophthora* on 78 varieties and species of citrus, all varieties and strains of lemon proved very susceptible. Sour oranges (*Citrus aurantium* or *C. bigaradia*) and two varieties of citron (*C. medica*) were very resistant. Grapefruit and sweet oranges varied considerably in their reaction to the fungus, some varieties approaching sour oranges in resistance while others were nearly as susceptible as lemons. Tangerines (*C. nobilis* var. *deliciosa*) were much less resistant than grapefruit and sweet oranges, their reaction being similar to that of rough lemons and limes. The Sanford, Savage, and Cunningham varieties of citrange (*C. sinensis* × *Poncirus trifoliata*) proved resistant.—(*Rev. of Applied Mycology*, Vol. IX, Part 5.)

* * *

The Enemies of *Elaeis*, by P. Staner.

In this account of the principal diseases of oil palms (*Elaeis* [*guineensis*]) in the Belgian Congo the author states that the leaves are sometimes attacked by *Sphaerella elaeidis*, an *Amphisphaeria*, and a *Colletotrichum*, the two former producing greyish spots while the last-named causes a characteristic zonation of concentric, brown and grey transversal bands on the leaflets, black fructifications being visible in all lesions. Small brown, later greyish-green superficial spots on the leaves are caused by *Cephaleuros virescens* (*C. mycoidea*). The hollow trunk disease due to *Ganoderma applanatum* is prevalent on adult palms; opposite the point of insertion of the sporophores, near the base of the trunk, a cavity extends through one-third or one-half of the heart of the palm and is filled with woody detritus and whitish mycelium. Frequently only fall n trees show the sporophores. Over-ripe fruits are affected by *Phytophthora* and a *Fusarium*.—(*Rev. of Applied Mycology*, Vol. IX, Part 5.)

CHEMICAL NOTES.

Compiled by the College Department of Chemistry and Soil Science.

The Disposal of Rice Husks.

Italy is confronting the problem of the advantageous disposal of 16,900 tons of rice husks annually. Dry distillation is suggested as the best means of treatment. A liquid which represents about 60 per cent. of the original weight of husk can thereby be easily obtained. Its main constituents are acetic and propionic acids, furfural, phenol and cresols, all of which could be separated and used. The carbonaceous residue which is of low density might also be of value. The ash, which forms 15.17 per cent. of the original husk, consists mainly of silica (93-95 per cent.) the remainder being formed of lime (2.28 per cent.), potash (3.15 per cent.) and traces of iron, manganese and aluminium. It is suggested that this ash might be used in the glass industry.

Bacterial decomposition of the husks with the formation of alcohol and the lower fatty acids, might offer another method of utilising this considerable waste material.—(*Brit. Chem. Abs. B.*, p. 528, 1930.)

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Coconut Husks as Fuel.

The large quantities of coconut husks obtained in the production of copra may be utilised as a source of coconut fibre, in the manufacture of coconut charcoal, or as a fuel in estate furnaces. The markets for coconut fibre and coconut charcoal are limited and only a small proportion of the total production of husks is required for fuel. With the idea of extending the use of husks as fuel, an investigation of their calorific value has been conducted in New Zealand (*New Zealand Journ. Sci. and Tech.*, Vol. XII, p. 14). Husks from the Cook Islands were separated into three portions, namely, outer skin, fibrous husk, and shell, representing 21.5 per cent., 49.6 per cent., and 28.9 per cent., respectively, of the whole husk. Determinations of the calorific values of these three materials gave average values of 4,113, 4,113, and 4,387 gm.-cal., respectively. The whole material gave a value of 4,192 gm.-cal. These results show that coconut husks have a calorific value of somewhat less than half that of a good grade coal. The excessive bulk of the husk restricts its general utility as a fuel.—(*Brit. Chem. Abs. B.*, p. 890, 1930.)

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Treatment of Cacao.

Many attempts have been made to devise a rapid and standardised method for preparing cacao beans for the market. Few have been in any way successful. Even when an apparently satisfactory bean is obtained it is generally claimed that the flavour and aroma of the artificially treated bean is inferior to that prepared by the traditional fermentation and sun drying process. A recent German patent describes a method which attempts to hasten and standardise the old process while still retaining the factors which are considered to be responsible for the production of a high grade bean. The ordinary fermentation box is replaced by a transportable box fitted with ventilation pipes. These pipes allow free circulation of air through the mass of fermenting beans, thereby preventing overheating and promoting alcoholic rather than the undesirable acetic fermentation. Periodic turning of the beans is thus obviated. The drying process is commenced by placing the fermented beans in a closed space at a temperature below 50° C. The beans swell and change colour and by oxidation become less bitter. A current of air heated to 60° C is then introduced and the drying continued but not completed. The drying is finally completed by circulating air at atmospheric temperature over the warm beans. By so regulating the temperature, the enzymes in the beans are preserved.

A further patent prescribes soaking the beans for two to twelve hours in water at 60° C. before roasting. It is claimed that this treatment extracts most of the volatile and bitter constituents, thereby enhancing the true chocolate flavour. Moreover, subsequent roasting is more uniform, and complete removal of the shell more easily obtained during winnowing.—(*Brit. Chem. Abs.* B. 792, 1930.)

SISAL IN EAST AFRICA.

THE potential output of sisal by the British East African Dependencies during 1929 amounts to nearly 60,000 tons, or in round figures 40,000 from Tanganyika, 17,000 from Kenya and 1,500 from Nyasaland. Extended areas are continually being planted. Much interest has centred lately upon the question of the possibilities of recovery of fibre from the waste which has hitherto been lost. There is an optimistic feeling that something like £20 per ton could be obtained for recovered fibre, and the importance of the discovery of a successful method of saving this amount to the industry can be gauged by the fact that this increased revenue would about cover factory costs. The Sisal Growers' Association has many other important matters in hand. Inquiries have been pursued into the possibilities of sisal fibre being used as a substitute in the jute and artificial silk industries, so far without any appreciable success. The question of the extraction of power alcohol from sisal stumps is also being examined. But the chief interest probably centres upon the proposals that the Association has made to the Government of Kenya for industrial research, much upon the lines of the proposals made by the coffee industry. A commencement of sisal production in Uganda has been made by the establishment of one estate. The half-yearly figures in the appendices show a further increase in sisal exports from Nyasaland. The areas under this plant are still being extended, and a steady increase in production may confidently be expected in the Protectorate.—(*Report of the Department of Overseas Trade.*)

Mr. GASTON de VERTEUIL.

It is with deep regret that we have to record the sudden and very unexpected death of Mr. Gaston de Verteuil, a prominent member of a distinguished family long and honourably identified with agriculture in Trinidad. Mr. de Verteuil had always shown a keen interest in the research work of the College to which he was a frequent visitor. His kindly help and genial and generous hospitality will be remembered with gratitude by many of the students and members of the Staff who knew him. Our very sincere sympathy is extended to his family and relatives.

C.Y.S.

Sir FRANCIS WATTS.

Resolution of Sympathy.

The following resolution moved by Sir James Currie was carried unanimously at the 82nd meeting of the Governing Body of the College which was held at the Colonial Office on 8th October: "That the Governing Body of the Imperial College of Tropical Agriculture in meeting to-day assembled desire to place on record the deep regret with which they have learnt of the death of Sir Francis Watts, K.C.M.G., D.Sc., the First Principal from 1921 to 1924 and latterly *Principal Emeritus* of the College, to the establishment of which he contributed so materially, and that the expression of their sincere sympathy be conveyed to Lady Watts and the family."

AGRICULTURAL EXCURSIONS.

A visit was made to the Caroni Estates on Wednesday, 29th October when an opportunity was afforded to Post-Graduate students of seeing at first hand some of the recommendations of the Froghopper Investigation Committee that are being put into practice.

Froghoppers are not greatly in evidence this year but in one place sufficient numbers of the third brood remained to enable practical demonstrations to be given. Before leaving the College, the party was addressed by Professor Hardy who explained in detail the scientific work of the Committee and the general conclusions that have so far been arrived at. Direct measures against the pest by means of dusting with cyanogas were demonstrated in the field by the courtesy of the management of Caroni Estates Ltd., the effect of cultural operations by such means as deep ploughing in the dry season were also explained and the possibility of natural control by Green Muscadine fungus or egg parasites were discussed. One of the results of this investigation has been to emphasize the importance of ecological studies and the connection between incidence of blight and the lime status of the soil was fully gone into by Professor Hardy and Mr. Turner.

Transport arrangements and other facilities were afforded by the Estate and thanks are due to Mr. W. H. Gilbert and his Staff for the opportunity of spending a profitable morning.

G. E.

COLLEGE NEWS.

Dr. C. W. Wardlaw, Banana Pathologist and Mr. A. K. Briant, Lecturer in Mycology returned from England by s.s. *Ariguani* on 15th November.

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Mr. E. E. Cheesman, Professor of Botany and Genetics accompanied by Messrs. F. J. Pound and E. E. Pyke arrived from England by s.s. *Cavina* on 1st November.

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Our thanks are due to Messrs. A. and J. Main & Co., Ltd., Australia House, Strand, London, W.C.2. for their gift of fencing droppers which were presented to the College for teaching purposes.

* * *

Mr. G. V. Wickramasekera, Dip. Agric. (Poona) is not, as announced in our last issue a Special Student, but is taking a Refresher Course at the College. He is Assistant Botanist on the Staff of the Ceylon Agricultural Department.

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Mr. E. E. Pyke, who has been appointed Physiologist to the Cacao Research Scheme was educated at the Sloane School, Chelsea and at the Royal College of Science, South Kensington, where he obtained the B.Sc. degree in Botany with first class honours.

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Mr. F. J. Pound who has been appointed Geneticist to the Cacao Research Scheme was educated at Sexey's School, Bruton and at Reading University, where he passed the London General External examination for the B.Sc. and the Special Botany examination.

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Mr. J. A. McDonald, Chemist to the Cacao Research Scheme, took up his duties as from 1st November. Mr. McDonald took the Diploma of the Imperial College of Tropical Agriculture and also gained the Associateship. Prior to his present appointment he was a member of the Staff of the Department of Agriculture, Trinidad, as Chief Inspector under the Plant Protection Ordinance.

* * *

Amongst recent visitors to the College were Mr. G. E. Anderson, Attorney of Plantation Diamond, British Guiana; Mr. A. L. Raeburn, Antigua; Mr. W. B. Barlow, British Guiana; Mr. T. A. Twyman, Managing Director, Montserrat Co. Ltd., Montserrat, Mr. D. Reid, Liliendaal, British Guiana; Mr. E. B. Martyn, Mycologist, Department of Agriculture, British Guiana; Mr. C. Fairall Fisher, President, Windsor Fisher, Ltd., Montreal, Canada; Messrs. H. Letovsky, E. Malen, L. A. Sendel of the Canadian-British West Indies Produce Co., Ltd., Montreal, Canada; Mr. J. Loudon, the Hague, Holland; and Mr. E. R. Skipwith, Representative of the *Financial Times*, London.

TREND OF THE MARKETS.

[*The notes below are based principally upon running charts of the prices of the basic grades and upon general statistical information gleaned from contemporary publications and cablegrams and are intended to be a record of movements. An attempt is made, where possible, to indicate the market outlook at the time of going to press, but no responsibility for the accuracy and subsequent truth of such observations is assumed. Unless otherwise stated the prices quoted are spot, London.*]

SUGAR.—Prices on the Home Market have ranged as follows (c.i.f. per cwt.) :—

	Foreign.	*Preferential.*
25th September	.. 5/3	9/4½
2nd October	.. 4/10½	9/4½
9th October	.. 5/3	9/4½
16th October	.. 6/2¼	9/4½
23rd October	.. 6/3	9/4½
30th October	.. 6/5¼	9/4½
6th November	.. 6/6	9/4½
15th November	.. 6/3	9/4½

After acute depression at the beginning of October when sugar fell to levels without precedent a welcome break in the monotony of the markets took place and important movements in favour of the article were recorded. This renewed firmness was largely due to various rumours and reports of an optimistic nature in regard to progress made by the Chadbourne Committee. It appears that the Chadbourne Plan which provides for the limitation of exports to the United States during 1931 to 2,800,000 tons and the carrying over of 1,500,000 tons for orderly marketing over a period of five years, has received the approval of a large majority of the Cuban Planters.

* * *

COCOA.—In sympathy with all commodities at the present time cocoa prices are very low despite the fact that stocks are not excessive. Crop reports from the Gold Coast indicate that pickings are late and this usually means a short crop.—(*By courtesy of The Cocoa Planters' Association of Trinidad.*)

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COTTON.—The following are the official spot prices in pence per pound of the Liverpool Cotton Association :

	American Mid.	*Egyptian F. G. F. Sakel.*	*Sea Island.*		
			Good.	*Extra fine.*	*Prices paid this Week.*
12th Sept.	6·30	10·30	24·50	38·00	7·20-9·00
19th Sept.	6·26	10·50	24·50	38·00	7·00-25·50
26th Sept.	5·89	10·05	24·00	38·00	—
3rd Oct.	5·76	9·80	24·00	38·00	—
10th Oct.	5·54	9·40	23·00	37·00	—
17th Oct.	5·73	9·55	23·00	37·00	26·00-26·50
15th Nov. .... (local)	6·02	—	23·00	37·00	—

On balance, lower prices for American have been recorded and the market has not shown any distinct tendency to improve. In Sea Island a limited business has been done at unchanged rates.

* * *

COFFEE.—The general trend of prices for Jamaica coffee since the middle of September has been downwards, recent prices recorded being 204*s.* per cwt. Kenya and Brazil have remained nominal at 90*s.* and 55*s.* while Costa Rica has shown a tendency to rise, present values being 146*s.* per cwt. for fine, 139*s.* for peaberry.

* * *

TEA.—There has been a general upward trend in tea sales, Ceylon rising from 17.31*d.* in July to 20.32*d.* in October and average sales from 14.20*d.* in July to 15.14*d.* in October ; some Nyasaland made 9.17*d.* Latest averages made 19.87*d.* per lb. for Ceylon, 14.33*d.* for Indian, 11.70*d.* for Sumatra and 11.02*d.* for Java.

There has been of late a good active market for all grades of Java tea, but for 1930 to date Great Britain has taken 5,000,000 lb. less of this type of tea than in 1929. The cause is not that Java tea is not appreciated or that its standard falls, but that the public has been buying higher quality tea, such as Ceylon.—(*Times, Trade and Engineering Supplement,* 25th October.)

* * *

RUBBER.—Quotations for Plantation Sheet have ranged as follows : 1st October, $3\frac{9}{8}d.$; 8th October, $3\frac{15}{16}d.$ 15th October, $3\frac{13}{16}d.$; 22nd October, $4\frac{1}{8}d.$ 29th October, $4\frac{7}{16}d.$; 5th November, $4\frac{3}{16}d.$; 15th November, $4\frac{1}{2}d.$

Prices after reaching their lowest at the beginning of October showed a slight tendency to rise by the middle of the month owing to current rumours that the Dutch might after all come into some restriction scheme and this steadier tone appears to have been maintained. Total World Stocks, according to Messrs. *Symington & Sinclair* are probably 480,000 tons or equal to rather more than seven months' consumption at the present rate.

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BANANAS.—Jamaicas continue in fair demand at the unchanged price to wholesalers of £21 delivered (London) or £20 10*s.* delivered nearest railway station ; the price to retailers is about 10½*d.* per dozen. Brazilians are in good demand and unchanged at £20 per ton delivered nearest railway station.—(*West India Committee Circular,* 16th October.)

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LIME PRODUCTS.—*Lime Oil.* Handpressed, which has been more freely offered, is valued at 44*s.* to 50*s.* according to quantity. Distilled is firm with fair sales at 31*s.* for shipment, and small sales at up to 32*s.* 6*d.* on spot. *Lime Juice.*—A good business has been done in Concentrated at £11. Raw is neglected and unchanged.—(*West India Committee Circular,* 16th October.)